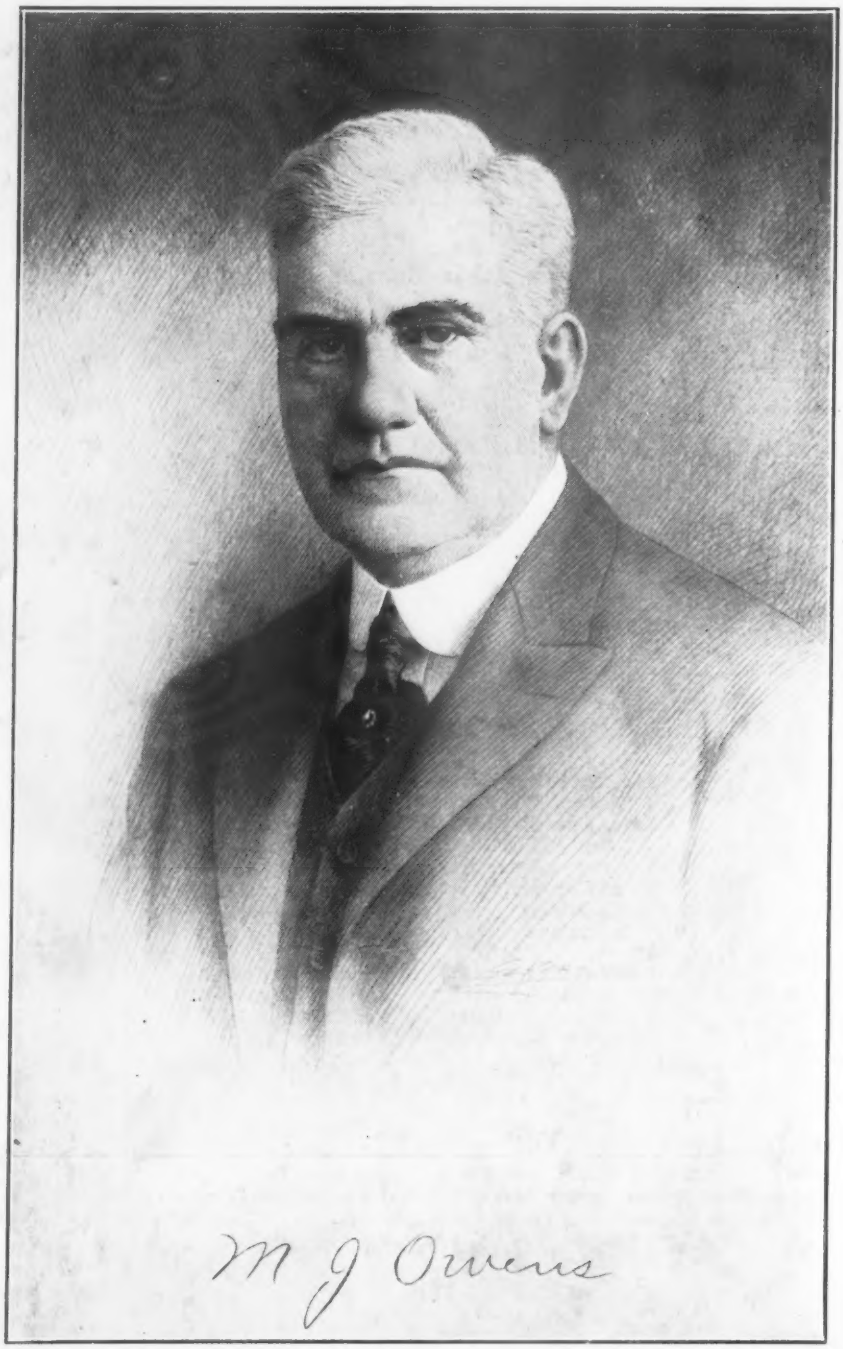
THE BULLETIN

OF THE

AMERICAN CERAMIC SOCIETY

Volume 17 MARCH, 1938 Number 3



PROGRAM

Fortieth Annual Meeting

March 27–April 2, 1938

Hotel Roosevelt
New Orleans, La.

For story, see page 148

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THE BULLETIN OF THE AMERICAN CERAMIC SOCIETY

Volume 17 March, 1938 Number 3

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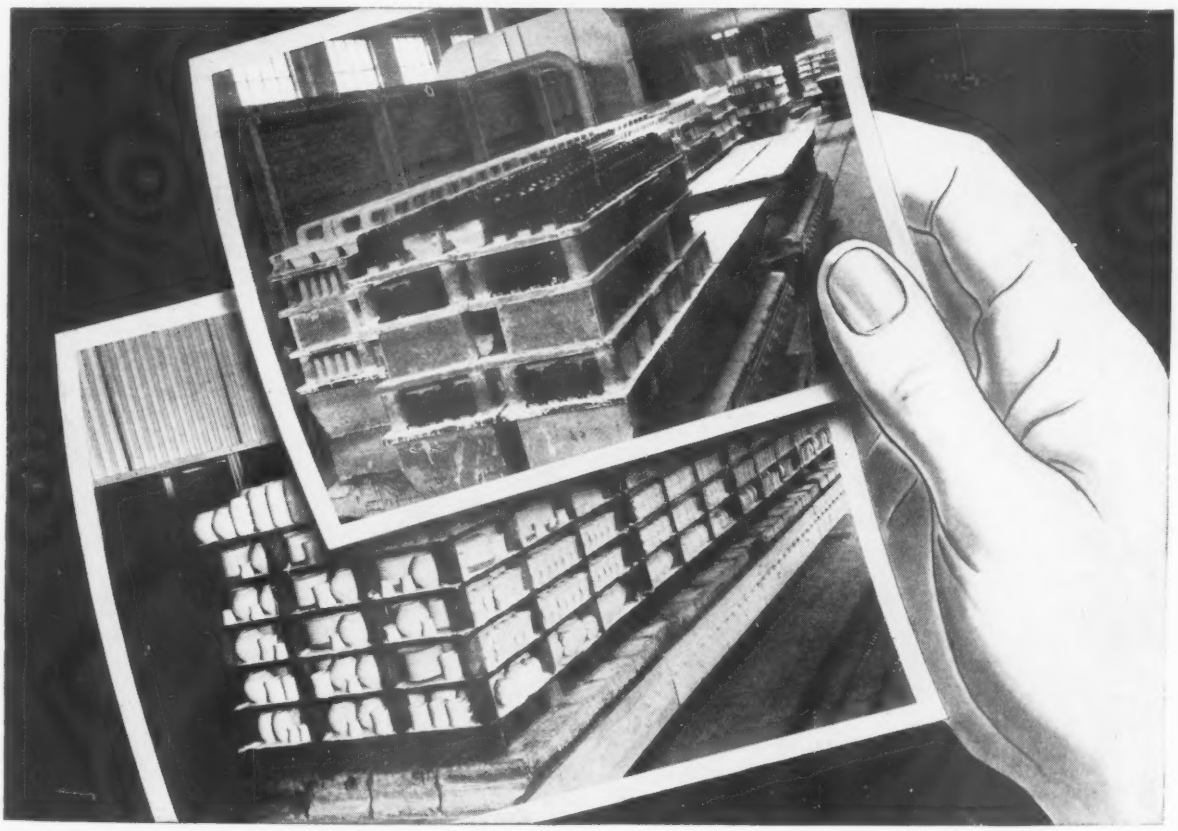

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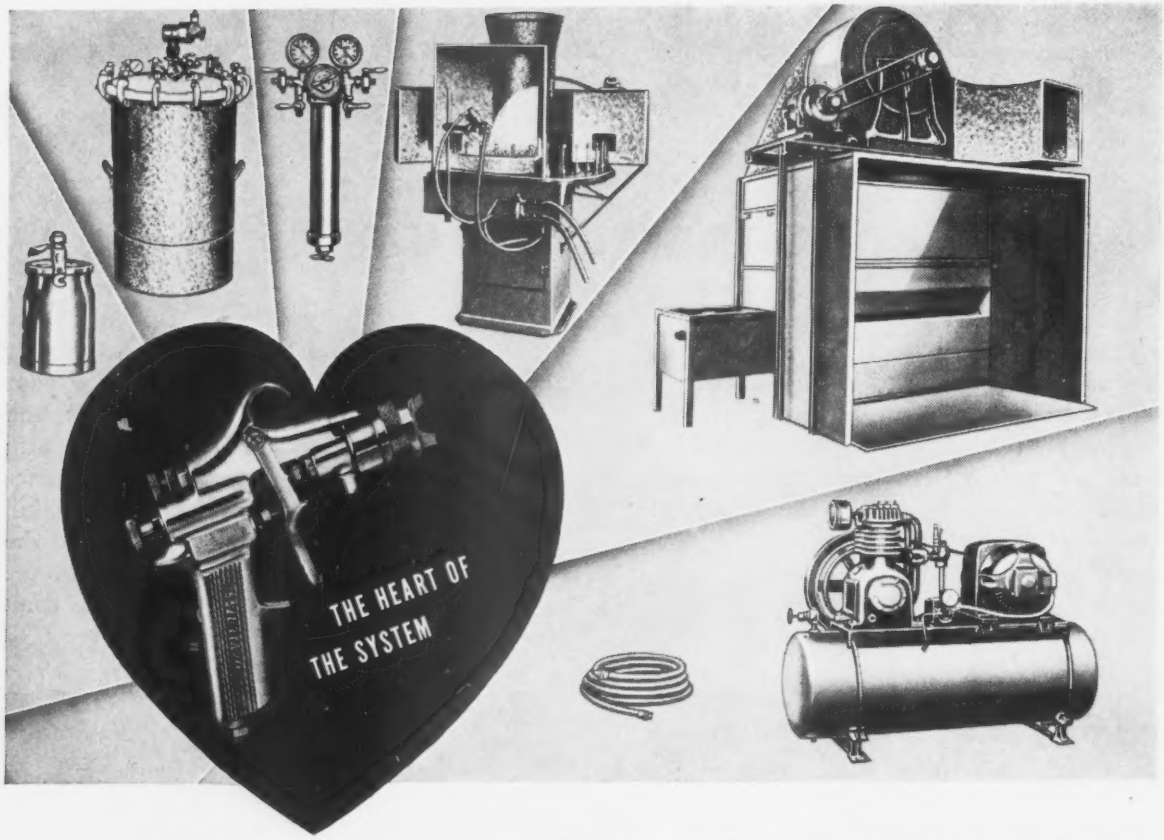

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THE BULLETIN

OF THE AMERICAN CERAMIC SOCIETY

A Monthly Publication Devoted to Proceedings of the Society and Promotion of Coöperative Research of Technical, Scientific, and Art Questions

VOLUME 17 **MARCH, 1938** **NUMBER 3**

FORTIETH ANNUAL MEETING, AMERICAN CERAMIC SOCIETY

MEETING SCHEDULES AND DIRECTORY

Headquarters for Meetings: Hotel Roosevelt

March 27–April 2, 1938, New Orleans

General Sessions: Grand Ball Room
Art Division: Room I
Enamel Division: University Room
Glass Division: Gold Room
Materials and Equipment Division: Room G
Refractories Division: Room E
Structural Clay Products and Terra Cotta Divisions: Room D
White Wares Division: Grand Ball Room

For Time Schedule see Chart below.

FORTIETH ANNUAL MEETING SCHEDULE

Registration Mezzanine Foyer

	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday
Forenoon		Board of Trustees 10:00 A.M.–1:00 P.M.—Room G	General Session—Geology of Ceramic Resources of Southern States 10:00—Grand Ball Room	General Session—Clay Constitution 9:30—Grand Ball Room Art Division 9:30—Room I Enamel Division 9:30—University Room Refractories Division Executive Meeting 11:00—Room E	General Session—Ceramic Construction Materials 10:00—Grand Ball Room Art Division 9:30—Room I	General Session—Symposium on Glaze and Enamel Properties 9:30—Grand Ball Room Refractories Division 10:30—Room E
Noon				Refractories Division Luncheon		
Afternoon	Board of Trustees 2:00–5:00 P.M.—Room G	Ceramic Educators 2:30—Room H Editorial - Publication Committees and Abstracters 4:00—Room E	A.S.T.M. Comm. C-8 2:30—Room D Art Division 2:30—Tulane University Art of South and Central American Ceramics (see Art Division Program) Fellows Meeting 4:00–6:00 P.M.—Room E	Division Meetings 2:00 P.M. Enamel—University Room Glass—Gold Room Materials and Equipment—Room G Refractories—Room E Structural Clay Products and Terra Cotta—Room D White Wares—Grand Ball Room	Division Meetings 2:00 P.M. Enamel—University Room Glass—Gold Room Materials and Equipment—Room G Refractories—Room E Structural Clay Products and Terra Cotta—Room D White Wares—Grand Ball Room Comm. on Divisions and Sections 4:00—Room I	General Session—Symposium on Glaze and Enamel Properties 2:00—Grand Ball Room Enamel Division 2:00—University Room Glass Division 2:00—Gold Room Refractories Division 2:00—Room E
Night		New Orleans Supper 7:00—Grand Ball Room—Dance 9:00—Entertainment—Dance	Institute of Ceramic Engineers 8:00—Room E	Keramos Meeting and Dinner 5:00 – 8:00 — La Louisiane, 725 Rue Iberville Student Dinner—Reception — Entertainment 7:00–12:00—Patio Royale, 417 Royal Street	President's Reception 8:00—Grand Ball Room Installation of Officers 8:30—Grand Ball Room Edward Orton, Jr., Memorial Fellow Lecture 8:45—Grand Ball Room	Art Division 8:00—Dixon Hall, Newcomb College

GENERAL SESSION ON CERAMIC RESOURCES OF SOUTHERN STATES

Hotel Roosevelt: Grand Ball Room

Monday Forenoon, March 28, 1938: 10 A.M.–12:00 M.

Chairman: R. B. Sosman, President, American Ceramic Society

1. Presidential Address: New Orleans and New York

By R. B. Sosman: Research Laboratory, U. S. Steel Corp., Kearny, N. J.

The President of the Society will pay his respects to the lustiest two of the New cities of the New World, to the one in retrospect of the Thirty-Ninth Meeting and to the other in anticipation of the Fortieth, with a brief study in contrasts that will be not without its ceramic interest.

2. Clays of Louisiana

By J. W. Whittemore: Dept. of Ceramic Engineering, Virginia Polytechnic Institute, Blacksburg, Va.

The geological history of the clay deposits of Louisiana is described. The physical properties of typical clays from several of the more important formations are included. It is shown that there should be a good future for the development of the clay deposits of this State because of the properties of the clay, cheap fuel, good markets, and available satisfactory labor.

3. Salt Domes and Their Ceramic Deposits

By R. A. Steinmayer: Tulane University of Louisiana, New Orleans, La.

Salt domes, unique geological formations, have been found, to date, only on the North American continent. As a class, they are characterized negatively insofar as ceramic deposits are concerned. In a few instances, however, where the intruded salt cores have risen to such heights as to impress themselves topographically, mound-like, into the otherwise featureless relief, there are accessible for exploitation such ceramic deposits as clay, limestone, gypsum, anhydrite, and sands. In addition, many domes bear associated economic deposits of minerals and mineral fuels.

4. Geology of the Nonmetallics of the Southeast

By Stewart J. Lloyd: Dean, School of Chemistry, Metallurgy, and Ceramics, University, Ala.

The general geology of the Southeast is relatively simple and can be set forth easily to the nongeologist. The important deposits of commercial nonmetallic minerals are not scattered indifferently throughout the whole territory but are attached to certain geologic units. It is the purpose of this paper to point out clearly such relationships.

5. Clays of Alabama

By T. N. McVay: Univ. of Alabama, University, Ala.

The important clays of the State are the kaolins, the stoneware, and the bauxitic clays of the Coastal Plain, the fire clays and shales of the Coal Measures, and the residual kaolins of the crystallines.

6. Ceramic Raw Materials of Arkansas

By G. C. Branner: Arkansas Geological Survey, Little Rock, Ark.

The clays of Arkansas are one of her great natural assets. They are widely distributed, abundant, and vary in their characteristics through a fairly wide range. Because the distribution of the clays is immediately related to the distribution of the rock types, the clays are discussed from the standpoint of these types. The rocks of the State may be divided into three classes as follows: (1) those lying within the Gulf Coastal Plain; (2) those lying within the interior highlands, and (3) those lying within the igneous areas. These, in turn, may be properly divided into the following six provinces: (1) the West Gulf Coastal Plain, (2) the Mississippi Alluvial Plain, (3) the Arkansas Valley, lying between the Boston Mountains and the Ouachita Mountains, (4) the Ozark Plateaus, (5) the Ouachita Mountains, and (6) the igneous area. The West Gulf Coastal Plain has proved to be the most important clay region of the State, and within this region the Wilcox formation of Tertiary Age has been much the most productive of commercial clays. Brick, tile and sewer pipe, fireclay products, and pottery are now produced from these clays. The Wilcox clays are especially accessible to railroads and highways and natural-gas trunk-lines. During 1937, seven clayworking plants were in operation in the West Gulf Coastal Plain, one in the Mississippi Alluvial plain, and one in the Arkansas Valley. The total value of brick and raw clay produced in Arkansas during 1937 is estimated to be $973,719. A systematic study of the clays of the State is much needed. A State-wide mineral survey with the assistance of WPA personnel and sponsored by the Arkansas Geological Survey is a first step in this direction.

7. Ceramic Raw Materials in North Carolina

By H. J. Bryson: State Geologist, Raleigh, N. C.

(1) *Feldspar:* North Carolina is the leading feldspar producing State. The total production of ground feldspar reaches one million dollars or more annually. The pro-

duction is about 52% of that consumed in the United States. (2) *Kyanite:* North Carolina is the leading kyanite producing State. One concentrating plant is in production; several small lenticular deposits have produced massive kyanite. (3) North Carolina is the leading *olivine* producing State; two quarries are in production and numerous deposits are distributed throughout western N. C. (4) *Pyrophyllite:* North Carolina is the only producer of pyrophyllite, a variety of talc which is used in the ceramic industry. (5) North Carolina is the leading *residual kaolin* producing State; six plants are in production and are capable of producing 40,000 or 50,000 tons annually. (6) *Spodumene:* Recent discoveries of spodumene in the Kings Mountain area reveal sufficient material to supply the demand indefinitely. (7) Numerous deposits of *quartz* and *quartzite* are distributed throughout the western part of the State, which will be suitable for the manufacture of glass and ceramic products. (8) *Talc:* A high-grade magnesium talc is produced in Cherokee County. It is used in the ceramic and paint industry, and it is said to be the finest talc produced in America. (9) *Vermiculite:* There are numerous small deposits of vermiculite in western North Carolina, which may be suitable for the manufacture of lightweight brick to back up refractory brick used for furnace linings. (10) *Sillimanite:* Two or three carloads of sillimanite were shipped from Clay County. This material is suitable for the manufacture of refractory materials. (11) *Corundum:* For many years N. C. was the leading producing State for corundum. This material has considerable value in the manufacture of spark plugs and other refractory products.

8. Ceramic Raw Materials of Oklahoma

By L. A. Sheerar: Oklahoma Geological Survey, Stillwater, Okla.

9. Ceramic Resources of Tennessee

By G. I. Whitlatch: Tennessee Division of Geology, Nashville, Tenn.

(1) Mining of ball clays and other high-grade pottery clays is the best known of Tennessee's ceramic industries, but the State also has abundant, widely distributed resources of shale, underclay, loess, and similar lesser grades of clay on which is based a substantial clayworking industry that annually produces a wide variety of finished ware. These industries, their products, and the general distribution and geologic occurrence of the raw materials are briefly described with accompanying ceramic and chemical data on certain representative types of clays. (2) In addition to the present commercially used ceramic resources, Tennessee has a number of other mineral resources, including tripoli, silica sands, limestone, dolomite, barite, manganese, kaolin, flint clay, bentonite, and bauxite, that are adaptable to ceramic uses. The extent, geologic occurrence, present development, and possible ceramic adaptations of each of these materials are summarily presented. (3) Feldspar and quartz, mined in the Spruce Pine district of North Carolina, are ground for the ceramic trade at Erwin, Unicoi County, Tenn. The economic importance of these materials to the establishment of high-grade ceramic industries in Tennessee is noted.

10. The Texas Ceramic Industry

By E. P. Schoch and David McKnight, Jr.: The University of Texas, Austin, Texas

Ceramic products of Texas consist almost entirely of brick, tile, and sewer pipe, although materials suitable for a good many other types of ware are available. The presence of these plentiful raw materials, as well as the availability of cheap fuel, combined with the rapid growth in population and industrial activity in this section should result in a rapid expansion of the ceramic industry in the immediate future. The need for coöperative effort in the industry is pointed out. This effort should be directed to the development of new products which will extend the applicability of clayware, particularly in the building trade.

11. Glass Sands of Alabama

By Walter B. Jones: State Geologist of Alabama, University, Ala.

There appear to be two glass sand deposits in Alabama, the Mohawk near Ohatchee, Calhoun County, and the Gulf Beach sands of South Baldwin. The former is a massive bedded sandstone, the latter a loose sand. The Hartselle sandstone, of Mississippian age, was used some years ago in glass manufacture at Birmingham, but the plant using it is closed.

GENERAL SESSION ON CONSTITUTION OF CLAY

Hotel Roosevelt: Grand Ball Room

Tuesday Forenoon, March 29, 1938: 9:30 A.M.–12:00 M.

Chairman: R. B. Sosman, President, American Ceramic Society
Associate Chairman: J. E. Eagle, Chairman, Materials and Equipment Division

9:30–10:00 A.M.

1. Relation of the Constitution to Properties of Clays

By R. E. Grim: State Geological Survey Div., Univ. of Illinois, Urbana, Ill.

Most clays are composed essentially of minute particles of one or more of a few groups of hydrous aluminum-silicate minerals. These are known as the clay minerals of which the kaolinite, montmorillonite, and illite groups are most important. They tend to occur in flake-shaped particles, to possess base-exchange capacity, and to exist in or to be reducible to extremely small grain sizes on working with water. Different clay minerals possess these properties in varying degrees, one of the important reasons for the range in clay properties. The properties of clays are related to the effective size-grade distribution developed in actual use which frequently differs from the size-grade obtained by mechanical analyses. The possible difference between effective and determined size-grade distribution varies with the clay mineral constitution of the clay. The clay mineral composition of clays is the chief factor determining their properties. In general, plasticity and bond strength caused by the clay mineral decreases in the following order: montmorillonite, illite, and kaolinite. The presence of the montmorillonite minerals and some members of the illite group cause these properties to be much higher than does kaolinite. In many clays the plasticity and bond strength mainly results from the presence of the montmorillonite minerals or some members of the illite group, although these constituents may compose only minor amounts of the clay. The influence of the clay minerals on other properties is considered. The green properties of clays are also related to the character of the exchangeable bases carried by the clay minerals. The fundamental reasons for the differences in properties resulting from different mineral constituents and various exchangeable bases are considered.

10:00–10:15 A.M.

2. A Unique Clay from the Goose Lake, Illinois, Area

By R. E. Grim and W. F. Bradley: Illinois State Geological Survey Div., Urbana, Ill.

There has been found recently a deposit of nonbentonitic clay in the Goose Lake area of Illinois with unique properties and composition which is marketed under the trade name, Grundite. The chief constituent of this clay was first thought to be beidellite, but further detailed microscopic, X-ray, and chemical studies have shown that it is composed of a distinctive mica clay mineral of the illite group. The clay possesses properties of plasticity, strength, and gel formation which have caused wide usage in a variety of fields. The paper discusses its occurrence, constitution, and properties.

10:15–10:30 A.M.

3. Critical Study of Methods of Determining Exchangeable Bases in Clays

By R. P. Graham and J. D. Sullivan: Battelle Memorial Institute, Columbus, Ohio

A study was made of analytical methods of determining exchangeable bases in clays and similar ceramic materials. Total exchange capacity can be determined by electrodialysis or by the leaching-distillation method. The time required for electrodialysis can be materially reduced by agitation of the clay slip during dialysis. Electrodialysis effects decomposition of bentonite and similar materials unless extremely low current densities are applied. Exchangeable cations of clays and similar materials are replaced slowly by percolation methods, but an agitation leaching-centrifuging procedure was developed which effects a rapid replacement. In ultimate analyses, by leaching methods correction must be made for soluble sulfates. Aqueous 1*N* ammonium acetate is a satisfactory leaching solvent for most clay bodies, but for those containing appreciable amounts of calcium carbonate alcoholic ammonium acetate should be employed. Details of recommended analytical procedures are given.

10:30–10:45 A.M.

4. The Relation between p_H and Electrophoretic Velocity in Certain Whiteware Clays

By E. C. Henry, N. W. Taylor, and G. S. Bachman: Dept. of Ceramics, Pennsylvania State College, State College, Pa.

Small amounts of several electrodialyzed clays were suspended in HCl and NaOH solutions of various strengths. The suspended particles appeared to be electronegative in the entire p_H range from 1 to 12. Each clay had a minimum electrokinetic migration velocity in an acid concentration corresponding to its p_H of exchange neutrality. These facts are applied to the interpretation of the viscosity changes which occur in slips of fixed clay-water ratio as the p_H varies.

10:45–11:00 A.M.

5. The Fractionation of a Clay into Closely Monodispersed Systems

By F. H. Norton and S. Speil: Dept. of Metallurgy, Massachusetts Inst. of Technology, Cambridge, Mass.

The advantages of studying a clay by dividing it into a series of nearly monodispersed systems is brought out. A method for carrying this out is described, using a Florida kaolin as an example. The size distribution in each fraction is measured by settling methods and good agreement is indicated between these sizes and the microscopically measured sizes.

11:00–11:15 A.M.

6. An Instrument for Measuring the Workability of Clays (published *Jour. Amer. Ceram. Soc.*, **21** [1] 33–36 (1938))

By F. H. Norton: Dept. of Physics, Massachusetts Inst. of Technology, Cambridge, Mass.

An instrument is described for measuring quantitatively the workability of clays, using the principle of twisting rapidly a tubular test specimen and recording the stress-strain diagram. Some results are given to indicate the value of this instrument.

11:15–11:30 A.M.

7. The Measurement of Particle Sizes in Clay (published *Jour. Amer. Ceram. Soc.*, **21** [3] 89–97 (1938))

By F. H. Norton: Massachusetts Inst. of Technology, Cambridge, Mass.
S. Speil: Edgar Brothers Co. Research Fellow, Massachusetts Inst. of Technology, Cambridge, Mass.

A simple method is described for measuring the complete range of particle sizes in a clay, with equipment which can readily be used in the plant-control laboratory. The usual Casagrande sedimentation method is extended to lower limits of size by swinging the suspension in a long arm centrifuge by which means particles can be measured as small as 0.05 micron. Distribution curves are shown for several types of clay and the precision of the results are discussed.

11:30–11:45 A.M.

8. Effect of Particle Size on Plasticity of Kaolinite

By H. Whittaker: Trenton Potteries, Trenton, N. J.

A Kentucky ball clay and a Georgia kaolin were resolved into seven practically monodisperse fractions ranging from 0.2 to 20 microns in mean size. The distribution of sizes and the physical characteristics of the fractions were determined in order to place the fractions on a comparable basis. Plasticity, drying shrinkage, and dry-strength measurements were made on the fractions. (2) It was concluded that there was no definite relationship between drying shrinkage and particle size, but in general the drying shrinkage increased with decreasing particle size. The drying shrinkage measurements, however, afforded a means for computing the thickness of water films at maximum plasticity developed. This computed thickness was between 40 and 60 Angstrom units at maximum plasticity. The dry strength increased in direct relationship with increased area of surface or decreasing particle size. (3) The optimum plasticity value, taken as the product of yield and strain, increased with increasing surface area according to the following relation, $\log S = AP + B$, where S is surface available per 100 grams of clay; P, the plasticity; and A and B, constants. B is equal to 157 for the particular kaolinite used. This means that there must be more than 157×10^4 square centimeters of total surface per 100 grams of clay on the basis of platelike particles before the material will exhibit plasticity. This surface represents a monodisperse system of particles approximately 2 microns in diameter. Systems containing particles over 2 microns exhibit the Osborne-Reynolds close-packing effect.

11:45 A.M.–12:00 M.

9. Grain Size of Whiteware Clays as Determined by the Andreasen Pipette

By G. A. Loomis: Engineering Experiment Station, Ohio State Univ., Columbus, Ohio

The Andreasen pipette method of determining grain sizes by sedimentation is a refinement of the ordinary pipette method. The apparatus was selected for the determination of grain size in a general study of clay casting slips after a consideration of other methods. It permits precise results but requires more time and precision than some other methods. Graphs are presented for typical American kaolins and ball clays, together with some for English china clays and ball clays for comparison.

GENERAL SESSION ON CERAMIC CONSTRUCTION MATERIALS

Hotel Roosevelt: Grand Ball Room

Wednesday Forenoon, March 30, 1938: 10:00 A.M.–12:00 M.

Chairman: R. B. Sosman, President, American Ceramic Society

10:00–10:20 A.M.

1. Relation between Pore Size of Brick and Their Resistance to Failure by Freezing

By R. T. Stull and P. V. Johnson: National Bureau of Standards, Washington, D. C.

In a study of pore structure of brick and its relation to disintegration by freezing, it was noted that the specimens of smallest pore size were in general those which failed earliest. Pore size, therefore, as well as the W/V ratio seems to exercise an influence on the behavior of brick during freezing. For "shale" brick comparatively free from flaws, the relation between the approximate number of cycles of freezing and thawing the brick will withstand can be expressed by the equation

$$c = K\frac{dV}{w}$$

Where c = number of cycles to cause failure
d = av. pore diameter (in microns) of specimen
V = per cent pore volume of specimen
w = per cent water volume in specimen
K = a constant

10:20–10:40 A.M.

2. Clay Units for Farm Buildings

By C. T. Bridgman: Structural Clay Products Institute, Ames, Iowa

(*1*) *Shapes and sizes of units used:* This will be a brief description of the structural clay face tile used for the various buildings. The units are 8- by 5- by 12-inch face tile, 8- by $3^5/_8$- by 12-inch face tile made to split, corncrib tile, silo blocks, and corner jamb blocks. (*2*) *Physical properties of the units:* A brief discussion is presented of the absorption, compressive strength, and color of the units. (*3*) *Types of buildings constructed:* A brief discussion is given of units recommended for farm houses, barns, cribs, hoghouses, grain storage tanks, poultry houses, and storage cellars. (*4*) *Wall cost comparison:* Comparative costs of the various types of walls with other types of competitive materials are discussed. (*5*) *Potential market of farm buildings for structural clay units:* A discussion is given of the rich market that can be developed by the clay products manufacturers for structural clay units. (Slides to show the shapes and size of units and colored moving pictures to show the types of farm buildings constructed of structural clay tile, a method for promoting the rich farm market, and the method of distribution used in this region are described.)

10:40–11:00 A.M.

3. Reinforced Floor Beams Made from Hollow Tile

By W. M. Dunagan: Theoretical & Applied Mechanics Dept., Iowa State College, Ames, Iowa

The results are given of a development in the use of precast, reinforced-tile beams assembled to produce a light, strong, and economical floor slab. Since the first use of reinforced-concrete masonry slabs, engineers have tried many ways to decrease the large dead loads to decrease the cost of the slabs. The most successful methods in flat-slab construction have been with the use of lighter aggregates and of hollow tile to create void spaces in the floor. Their consequent lightening influence is an improvement in insulation soundproofing, etc. A reinforced-tile slab construction method, which meets the requirements needed in present-day housing construction, has been developed. The method is described and the theory is developed upon which the floor system is based. Test results are given, and photographs of construction methods employed in the installation of the reinforced tile-slab floor are presented.

11:00–11:20 A. M.

4. Structural Glass

By G. M. Rapp: Pittsburgh-Corning Corp., Pittsburgh, Pa.

A definition and modern concept of "structural glass" is given, and the history and development of the more common types are reviewed. The adaptability or fitness of glass in general to the structural field is discussed and the structural properties of glass are described and compared with some other common building materials. Several new products in the field of structural glass are described, and some of the engineering problems involved in their proper use are presented. Illustrations of the application of methods of structural analyses and tests to this type of glass are included.

11:20–11:40 A.M.

5. Fiber Glass

By G. Slayter and J. H. Thomas: Owens-Illinois Glass Co., Newark, Ohio

Methods of manufacturing staple and continuous fiber glass and various applications for which its properties as an inorganic textile material make it especially adaptable are discussed. A film will be presented showing the process and methods of fabricating fiber glass into yarns, tapes, and cloths.

11:40 A.M.–12:00 M.

6. Ceramic Structural Materials in Old Louisiana Building

By Richard Koch: 908 Queen & Crescent Bldg., New Orleans, La.

Early brick-yards in New Orleans and the use of this material in their buildings are discussed with particular emphasis on roofing materials, such as Cuban tile roofs and French shingle tile. The construction of the Dome of the Hotel Royal is described. A light iron frame was built and filled in with tile in the form of pots, similar to the dome in the church at Ravenna. Slides of the old buildings will be shown.

WEDNESDAY NIGHT GENERAL SESSION

All members and the general public are invited to attend

Hotel Roosevelt: Grand Ball Room

8:00 P.M.: President's Reception
8:30 P.M.: Installation of Officers

8:45 P.M.: Edward Orton, Jr., Memorial Fellow Lecture
Emerson Poste, *Dean of Fellows*, Presiding

Subject: A Decade of Research on the Nature of Clay
Speaker: Paul F. Kerr, Columbia University, New York, N. Y.

The last decade has witnessed a great advance in knowledge of the fundamental mineralogy of clay. As the decade started, many different clay minerals, covering a wide variation in character, were thought to exist. These provided a large list of names, many of which were of doubtful validity. The progress of research throughout the decade has greatly simplified this list. The fundamental units in which clay may occur are much better known. It is now generally recognized that the more important clays are made up of comparatively few minerals with characteristics and origins that are fairly well understood. Many old names have gone into the discard. Problems concerning the mineral constituents of clays are by no means entirely solved. It seems, however, that the time has been reached when a great quantity of the fundamental information being produced in research laboratories, both in the United States and abroad, may be turned toward specific applications. It is believed that the ground work has now been laid which will result in a period of technological research comparable to the period of fundamental research of recent years.

The advances of the last decade have been largely brought about by coöperative research. The problems under investigation have been such that few individual investigators have had the training or the equipment necessary for the solution of the more important problems. As a result, nearly all of the more important contributions have been the work of two or more investigators. Not only have individuals coöperated, but there has been a fine spirit of coöperation between various institutions.

A résumé of men and institutions involved in clay mineral research, recent developments in clay mineral technique, efforts made to obtain satisfactory samples for study, treatments devised for handling samples to secure reliable results, and studies of the conditions under which clays are found in nature, provides an interesting chronicle which should be of interest to all who are concerned with that most important of natural products—clay.

GENERAL SESSION—SYMPOSIUM ON GLAZES

Hotel Roosevelt: Grand Ball Room

Thursday Forenoon, March 21, 1938: 9:30 A.M.–12:00 M.

Chairman: Albert V. Bleininger, Homer Laughlin China Co., Newell, W. Va.
Associate Chairman: R. F. Geller, Chairman, White Wares Division

1. Introduction to Symposium on Glazes

When we realize that a vast amount of study and investigation has been and is being devoted to the subject of the physical properties of glasses, it is apparent that we are lamentably ignorant of glazes. It would seem, as Ross C. Purdy suggested several years ago, that a general symposium on glazes would be of much importance. This is especially true when we consider the complex systems with which we are dealing here, complicated by the constant interaction between glaze and body, which in most cases is exceedingly intensive owing to the thinness of the glass layer.

Because the number of glaze types is so great, it might be advisable to restrict the Symposium to a limited number of commercial glazes, the practical working properties of which are relatively well known. The study of the properties of the glazes should not be confined to the characteristics usually considered but should embrace all of the physical qualities which can be estimated or examined. The investigation should be as broad and basic as possible, since only in this way could it yield adequate results.

We realize fully that much of the information desired is not available, but nevertheless a program should be mapped out which would arouse interest in the unknown factors and would incite workers to assist in filling the wide gaps in our information.

Attacking the subject from the purely technical standpoint, a group of members has submitted the following program, and we have been fortunate in securing the coöperation of outstanding technologists who have consented to function as leaders of the discussions on a number of topics. Owing to the wide scope of the program, it has not been possible as yet to cover all of the subjects. At the same time, it is realized that only a start can be made at this Meeting and that the work must be continued for a number of years if it is to be a profitable undertaking.

(1) Chemical classification of glazes.
By C. W. Parmelee: Univ. of Illinois, Urbana, Ill.

(2) Prefusion and fusion phenomena, especially in reference to vesicular structure and gas evolution.

(3) Porosity and shrinkage measurements from low temperatures to the beginning of fusion, correlated with temperature.

(4) Viscosity-temperature relation up to fusion.
By H. G. Schurecht: New York State College of Ceramics, Alfred, N. Y.

(5) Transformation point of glazes.
By F. H. Norton: Massachusetts Inst. of Technology, Cambridge, Mass.

(6) Softening point of glazes.
By A. S. Watts: Ohio State Univ., Columbus, Ohio

(7) Internal structure of fused glaze, with reference to immiscible layers, number, size, and distribution of bubbles and seeds. Presence of undissolved and crystallized material.

(8) Surface texture with reference to brilliancy or matness, surface films, reflecting power, smoothness, the presence of craters, blisters, and bubbles (as shown by suitable photography). The presence of undissolved and crystallized material.
By Edward Schramm: Onondaga Pottery Co., Syracuse, N. Y.

(9) Kind and degree of opacity and light transmission.

(10) Mean index of refraction.

(11) Type of post-fusion phenomena with special reference to extent of gas evolution and temperature.

(12) Color reflected as per spectrum analysis.

(13) Microstructure of boundary surface between glaze and body.

(14) Measurement of kind and degree of stress existing between glaze and body.
By F. H. Norton

(15) Thermal expansion of the glaze as such and when attached to the body.
By H. W. Thiemecke: Homer Laughlin China Co., Newell, W. Va.

(16) Mechanical properties of the fused glaze as such, with special reference to the modulus of elasticity, resistance to tension, impact, and abrasion.
By F. P. Hall: Pass and Seymour, Inc., Syracuse, N. Y.

(17) Effect of heat treatment of the glazes as such upon thermal expansion and irreversible volume changes.

(18) Effect of aging and storage of glaze rods under atmospheric and special conditions with special reference to volume changes and permanent set.

(19) Effect of glaze upon the mechanical properties of the body to which it is applied with reference to its mechanical strength and elongation under humid atmospheric conditions.
By J. H. Koenig: Ohio State Univ., Columbus, Ohio

(20) Hardness of glazes.
By F. P. Hall

(21) Resistance of glazes to chemical agencies.

(22) Chemical changes during the firing of glazes.
By Edward Schramm

(23) Volatilization of glaze constituents to adjacent surfaces.
(24) Wetting ability of fusing glazes.
By H. G. SCHURECHT
(25) Effect of kiln atmosphere upon glazes.
By ROBERT E. GOULD: Ceramic Laboratory, TVA, Norris, Tenn.
(26) Glaze attack upon bodies of varying porosity.
(27) The application of glazes.
By L. H. BROWN: Hall China Co., East Liverpool, Ohio

2. Problems in Whiteware Glazes

By EDWARD SCHRAMM: Onondaga Pottery Co., Syracuse, N. Y.

In much published work on glazes, the only criterion of a good glaze is freedom from crazing. It may now be assumed that this requirement can be met, and it is time to consider the other specifications of an ideal glaze which include (1) brilliant appearance, (2) compatibility with colors, and (3) maximum serviceability. These properties vary with glaze composition but also depend on the conditions of application and firing. The conditions of application involve the control of glaze consistency and the adaptation of technique to the nature of the ware. Under firing conditions, the following points are considered: the manner of compounding a glaze of given end composition, the course of fusion, the interaction of body and glaze, and the effect of kiln atmosphere or other environment on glaze development. Examples are given to indicate that all these factors may be studied experimentally.

General Session—Symposium on Glazes (continued)

Hotel Roosevelt: Grand Ball Room

Thursday Afternoon, March 31, 1938: 2:00 P.M.–4:30 P.M.

Chairman: Albert V. Bleininger, Homer Laughlin China Co., Newell, W. Va.
Associate Chairman: R. F. Geller, Chairman, White Wares Division

3. Effect of Glaze Film on Bisque Properties

By J. H. KOENIG: Engineering Experiment Station, Ohio State Univ., Columbus, Ohio

Tests were made on commercial dinnerware bodies using unglazed and glazed specimens. The properties observed included flexural, tensile, and compressive strengths, elasticity, fatigue, thermal expansion, and the resistance to mechanical abuse.

4. Evaluation of Methods for Determining Glaze Fit

By W. C. BELL: Engineering Experiment Station, Ohio State Univ., Columbus, Ohio

Different methods for evaluating glaze fit have been suggested from time to time. Several modifications of each basic method have been offered. It was the purpose of this investigation to compare the methods using a dinnerware body and glaze. The glazes were applied and fired in a commercial way. Modifications of the ring, the flat plate, and the cantilever beam test have been compared.

5. Elimination of Glaze Defects by Control of the Glaze Consistency

By W. R. MORGAN AND W. B. MCDEVITT: Dept. of Ceramic Engineering, Univ. of Illinois, Urbana, Ill.

Crazing and blistering of a raw lead glaze were eliminated by regulation of the dipping weight through control of the consistency of the dipping glaze.

6a. Life History of a Glaze: I, Reactions Occurring During Heating Up a Whiteware Glaze

By A. M. BLAKELY: Dept. of Metallurgy, Massachusetts Inst. of Technology, Cambridge, Mass.

The reactions occurring during the heating-up period of a whiteware glaze were studied by quenching a series of specimens withdrawn from the kiln at various stages of the firing cycle. These specimens were sectioned and studied under the petrographic microscope to determine the progress of the reaction. Curves are presented showing the volume of quartz, feldspar, and bubbles in the glaze at various stages, and photographs indicate the progress of the reactions.

6b. Life History of a Glaze: II, Stresses Occurring in a Whiteware Glaze under Various Conditions of Cooling

By A. M. BLAKELY: Dept. of Metallurgy, Massachusetts Inst. of Technology, Cambridge, Mass.

The stresses occurring in a whiteware glaze under various conditions of cooling are measured in a new type of furnace using a specimen in the form of a tuning fork, with the glaze on the outside of the prongs. The change in spacing of the tips of the prongs is converted into glaze stress for which an exact mathematical relationship is developed for the first time. It is found that in whiteware glazes the transformation point in quartz comes at about the same temperature as the transformation point in the glaze. Therefore, an alteration in the softening point of the glaze often has a more important influence on the stresses developed than do changes in thermal expansion.

ART DIVISION PROGRAM

Chairman: C. M. Harder, N. Y. State College of Ceramics, Alfred, N. Y.
Secretary: M. L. Fosdick, N. Y. State College of Ceramics, Alfred, N. Y.
Program Chairman: L. E. Barringer, General Electric Co., Schenectady, N. Y.

General Session at Tulane University and Newcomb College

Monday Afternoon, March 28, 1938: 2:30 P.M.–5:00 P.M.

1. Pottery of the Past (with Special Reference to the Pottery of Ancient America)

By Frans Blom: Dept. of Middle American Research, Tulane University of Louisiana, New Orleans, La.

It is pointed out that the records of man's artistic effort in the most remote times are preserved in fired clay. Pottery has through all times shown the period and the artistic ideals of man in all parts of the world. Special mention is being made of the ceramics of the ancient peoples of Central and South America. The lecture is illustrated with original examples of Maya, Aztec, Huastec, Chimu, and Nasca pottery.

2. Art in the South

By Ellsworth Woodward: Isaac Delgado Museum of Art, New Orleans, La

Art in the South is not regarded seriously in the artistic councils of the nation, and the reasons which explain this situation are not widely understood. Writers on this subject have been content with slighting references, and there has appeared no thoughtful inquiry to explain the retarded status of a matter so universally important. The southern section of our land has been agricultural rather than industrial. Art is not fostered by agriculture but by industry. The South has no large cities. Wealth embarked in commerce rather than manufacture does not stimulate competition in the production of articles entering into world trade. Schools of art have been wanting, and the need for museums of art has not been urgently apparent. Artists seeking instruction and patronage have deserted the South. This constant withdrawal of talent by reason of lack of support characterized the past and continues into the present. At the close of the Civil War, art came to a complete standstill. Generations expended their entire energies to rebuilding the material necessities of society. A full understanding of the backward cultural standing of this section is conveyed by reflection upon the historic pageant. The distant past displays a rich inheritance of gracious living surrounded by evidences of cultivated taste, derived rather than created. The artistic renascence of the southern section dates with the present generation. Schools, reviving public understanding, museums of art, art education in its wider application, growing patronage for the artists, and an awakening appreciation of mutual interdependence, all these are factors in the changing times which characterize the South of today.

3. Some Aspects of Pottery Development Work in Mexico (published in this issue, p. 157)

By B. W. Thorngate: Florida Ceramics Co., Pensacola, Fla.

The results of some of the experiments made for a company interested in technical industries in Monterrey, Mexico, are given in this paper.

Art Division Program (continued)

Hotel Roosevelt: Room I

Tuesday Forenoon, March 29, 1938: 9:30 A.M.–12:30 P.M.

4. Origin, Development, and Present Status of Newcomb Pottery

By Kenneth E. Smith: Newcomb Pottery, New Orleans, La.

A descriptive résumé is presented of the history and purpose of one of the first art potteries to be organized on a semicommercial basis within an educational institution. Newcomb Pottery was founded in 1896 at Newcomb College, New Orleans, La., as an integral part of that institution which was founded ten years before within the Tulane University of Louisiana for the higher education of white girls and young women. The financial success of the pottery was to be kept secondary to its artistic success. The object of its existence was to provide an outlet for the work of graduates of the Newcomb Art School. Artistic and technical guidance has been given to the Pottery by several well-known artists and ceramists during its forty years. The methods of production have changed very little since its first ten years, which period was one of experimentation mainly in different decorative treatments. All of the pottery is thrown on the wheel or hand-built and

is decorated by graduate students of the Art School. The ware is offered for sale at the college and in several stores throughout the nation. The decorators receive a proportion of the retail price of each piece. There is now a decided effort to train the students in the classrooms and studios to make as well as to decorate pottery of an individual nature, which will be marketed in the usual way.

5. Use of Lithium Carbonate in Raw Alkaline Glazes

By Florence Wood Richardson: Dept. of Fine Arts, Ohio State Univ., Columbus, Ohio

The results of using lithium carbonate to replace more soluble alkalis and their frits in glazes fired between cones 07 and 05 are discussed. Owing to its unusual fluxing properties, the use of from 9 to 12% lithium carbonate permits a marked increase in the amounts of alumina, calcium, and silica which may be used, resulting in a more stable glaze, with sufficient alkalinity to produce vivid copper blues and other typically alkaline colors.

6. Intaglio Printing in the Dinnerware Industry

By G. H. Stapleford: Homer Laughlin China Co., Newell, W. Va.

Although extensively used by many manufacturers of china and semivitreous dinnerware for the decoration of their products, the technical details of this printing process have been somewhat neglected by compilers of past pottery textbooks. The main object of this paper, therefore, is to treat the subject comprehensively as practiced in several of the modern up-to-date plants throughout the country.

7. Manufacture of Porcelain near Tehwa, South China

By W. J. Sutton: Alfred, N. Y.

Tehwa was the most famous center for the production of blanc de Chine during the Ming and ching dynasties, beginning in the Fourteenth Century, and is considered the second most important center in China in its influence on the work of potters in Europe and America. Owing to its inaccessibility, relatively few visitors have seen the work carried on in this old center. The processes still in use are about the same as they have been for centuries, except that overglaze decoration is now quite common. The Tehwa kilns are efficient and are undoubtedly the best developed in China. The steps in manufacture are described, accompanied by many illustrations.

Art Division Program (continued)

Tuesday Afternoon, March 29, 1938

Visits to museums, studio potteries, or other places of ceramic interest. General sightseeing for those who prefer it.

Hotel Roosevelt: Room I

Wednesday Forenoon, March 30, 1938: 9:30 A.M.–12:30 P.M.

Papers remaining from the Tuesday session
Election of Officers
Discussion of Fall Meeting
Adjournment

Wednesday Afternoon, March 30, 1938

Visits to museums, studio potteries, or other places of ceramic interest. General sightseeing for those who prefer it.

Dixon Hall, Newcomb College

Thursday Evening, March 31, 1938: 8:00 P.M.

Lecture on "Ceramic Art"

By R. Guy Cowan: Syracuse, N. Y.

ENAMEL DIVISION PROGRAM

Chairman: F. R. Porter, Inland Steel Co., Hammond, Ind.
Secretary: B. J. Sweo, Ferro Enamel Corp., Cleveland, Ohio
Program Chairman: G. H. Spencer-Strong, Porcelain Enamel & Mfg. Co., Baltimore, Md.

Hotel Roosevelt: University Room

Tuesday Forenoon, March 29, 1938: 9:30 A.M.–12:30 P.M.

9:30–10:00 A.M.

1. Sag-Resisting Properties of Enameling Iron

By F. R. PORTER: Inland Steel Co., East Chicago, Ill.

The paper deals with the method of determining sag-resisting properties and the effect of composition of iron, gage, and temperature on sag values. A theoretical consideration of the deflection of beams is also given. Two types of test strips were used, one 12 inches long and supported near the ends; the other 5.55 inches long and supported at one end (cantilever type). There is merit to both methods, but the author favors the method involving the use of a strip supported near the ends. The composition was found to affect the sag values found; mild steel contained more carbon and manganese than enameling iron and showed considerably higher sag values. The gage of the test strip affected sag values: the heavier the gage, the less the sag values. Sag values increase as the temperature is increased. The increase is rapid, particularly above 1550°F, for enameling iron.

10:00–10:30 A.M.

2. Preliminary Reports on the Study of Nickel Dip

By DIVISION RESEARCH COMMITTEE: W. N. HARRISON, *Chairman*

10:30–11:00 A.M.

3. Inhibitors in Steel Pickling

By C. P. WEISE: Grasselli Chemicals Dept., E. I. du Pont de Nemours & Co., Cleveland, Ohio

The character of oxide scale on sheet iron is described and the mechanism of its removal by acid pickling discussed. Various types of inhibitors are noted and the mechanism of their functioning is described. One of the chief objections to the use of inhibitors in the pickling of enameling stock has been the desire for a deep etch to aid adherence. A plan of pickling whereby the benefits of inhibitor-controlled pickling may be gained and at the same time a satisfactory etch obtained is described.

11:00–11:30 A.M.

4. Study of Milling and Its Effect on Some Properties of Porcelain Enamel Slips

By R. L. FELLOWS AND J. L. MCLAUGHLIN: Chicago Vitreous Enamel Product Co., Cicero, Ill.

In studying the effect of some of the variables in ball-mill operation on porcelain enamel slips, it was found that variation in the amount of frit charge, amount of ball charge, size of balls, and r.p.m. of mill changed the fineness distribution of a white steel enamel. Other variables, such as the water content, temperature of milling, and pressure under which enamel is milled had apparently little effect on the fineness distribution of the enamel. The effect of these variables on some of the other properties of the enamel is also discussed.

11:30 A.M.–12:00 M.

5. Study of the Effect of Some Electrolytes on the Consistency of a Dipping Enamel

By R. J. WHITESELL: Rohm & Haas Co., Philadelphia, Pa.

A comparison was made of the effect of various electrolytes on the consistency of a dipping enamel. Results indicate that the order of preference of the electrolytes tested is sodium nitrite, barium chloride, magnesium sulfate, potassium carbonate, and hydrochloric acid. The influence of the anion on the effect of various sodium compounds as electrolytes was determined.

12:00 M.–12:30 P.M.

6. Some Data on Enamel Solubility

By J. D. TETRICK: Baltimore Enamel & Novelty Co., Baltimore, Md.

Data are presented on the solubility of several enamels under various conditions of commercial milling.

Enamel Division Program (continued)

Hotel Roosevelt: University Room

Tuesday Afternoon, March 29, 1938: 2:00 P.M.–5:00 P.M.

2:00–2:30 P.M.

7. Modification of Bingham Plastometer (published *Jour. Amer. Ceram. Soc.*, **21** [2] 66–68 (1938))

By J. T. Irwin and R. E. Bevis: Ferro Enamel Corp., 4150 E. 56th St., Cleveland, Ohio

A brief review of the literature on methods of determining consistency of enamel slips is given, followed by a description of a simplified method, making use of two capillaries of different lengths, and involving only one time measurement and two volume measurements per determination.

2:30–3:00 P.M.

8. Application and Use of the Irwin Consistometer in Enamel Slip Control

By J. F. Hunt and L. J. Frost: The Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

The following points are discussed in this paper: (1) the effect of 7 clays is determined on the set of a sheet-steel cover-coat slip; (2) the effect of 10 electrolytes is determined on the set of sheet-steel ground-coat, cover-coat, and acid-resisting slips; (3) the effect of 4 opacifiers is determined on the set of a sheet-steel cover-coat and acid-resisting slip; (4) a draining ground coat and a steel spraying cover coat were ground to varying finenesses, and the effect of fineness was determined on the set of these slips; (5) a steel ground-coat, cover-coat, and acid-resisting enamel were aged through different periods of time, and the effect of aging was determined on the set of the slips; (6) various percentages of water were milled into a steel ground coat and cover coat, and the effect of increasing water additions was determined on the set of the slips; (7) a one-coat hollow-ware enamel was used, and the effect of increasing Epsom salts additions was determined on the set of the slip; and (8) steel ground and cover coats were run at different temperatures and checked as to the effect of increasing temperature on set. All of the results are represented in curve form on cross-section paper, and a comparison of good and poor slips is made from a set and workability standpoint.

3:00–3:30 P.M.

9. Some Observations on the Function of Adhering Oxides in Ground-Coat Enamels

By Karl Kautz: Alloy Steel Div., Republic Steel Corp., Massillon, Ohio

Five enamels were smelted which contained variously no adhering oxides, $^1/_2$% CoO, $^1/_2$% NiO, 1% MnO_2, and all adhering oxides listed. These frits were milled and a study was made of the effect of these oxides upon (1) adherence of the glass to iron, (2) oxide film formed under the glass, (3) ability of the glass to dissolve iron oxides at enameling temperatures, (4) ability of the glass to carry or transmit oxygen from the air to the iron base at enameling temperatures, and (5) relative fluidity of the glass at enameling temperatures. The results are tabulated and illustrated photographically.

3:30–4:00 P.M.

10. The Oxide Film between Fired Ground-Coat Enamels and Iron

By Karl Kautz: Alloy Steel Div., Republic Steel Corp., Massillon, Ohio

A study of the oxide film between glass and iron was made by sticking together in a furnace pieces of fired ground coat and tearing them apart when cold so that the oxide film was separated from one of the iron surfaces. The chemical behavior of this film and its identification by microscopic, chemical, and X-ray methods all point to a composition which contains FeO as one constituent.

4:00–4:30 P.M.

11. Theory of Enamel Adherence

By J. E. Rosenberg: The O. Hommel Co., Pittsburgh, Pa.

A review of prevalent theories of enamel adherence does not explain the function of cobalt compounds in ground coats. The theory proposed is based on the chemical properties of cobalt and its compounds. While cobalt is more noble than iron and may be replaced from the enamel melt, other metals like copper and nickel, which are more readily replaced, do not produce adherence. Cobalt, aside from being replaced electrochemically, also acts as an oxidizing agent. It is this double function of cobalt to plate out and oxidize which is proposed as the explanation of its effect in ground coats.

4:30–5:00 P.M.

12. Variations in Impact Tests Caused by Specimen Shapes and Variables in Physical and Chemical Properties of Enamels Tested

By E. C. Dexheimer: National Enameling and Stamping Co., Granite City, Ill.

The author presents a definite and positive variation in impact figures due first to relation of the radii of curvature of the shapes tested and the coefficient of expansion of enamels used. He emphasizes the point that these figures depend not only on these two factors but also on the general class to which the enamel belongs as to whether the formula is (1) stainless, (2) ordinary, (3) antimony free stainless, and (4) antimony free ordinary.

Enamel Division Program (continued)

Hotel Roosevelt: University Room

Wednesday Afternoon, March 30, 1938: 2:00 P.M.–5:00 P.M.

2:00–2:30 P.M.

13. Mechanism of Mill-Added Opacity in Porcelain Enamels

By A. I. Andrews and B. W. King, Jr.: Dept. of Ceramic Engineering, Univ. of Illinois, Urbana, Ill.

The microscopic appearance of sheet-iron white cover enamels indicates that mill-added opacifiers function principally as layers between the frit particles and do not diffuse well into the enamel. This explains why mill-added opacifiers do not continue to increase reflectance when added in large quantities, why increased fineness of milling aids reflectance, why extreme fineness of opacifiers is necessary, and why transparent glassy frits appear mottled with mill-added opacifiers. From this observation, it is evident that great increases in reflectance of enamels must either originate in the frit or be brougha about by finer milling or better diffusion of mill-added opacifiers.

2:30–3:00 P.M.

14. Identity and Amounts of Fluoride Crystals Present in Enamels

By B. W. King, Jr., and A. I. Andrews: Dept. of Ceramic Engineering, Univ. of Illinois, Urbana, Ill.

A group of enamels containing fluorspar, cryolite, and sodium silicofluoride added in various proportions were prepared under carefully controlled conditions, including smelting in an electric-resistor furnace. The only mill additions were clay and water, no opacifier being used. X-ray diffraction patterns were made of the fired enamels, and from these patterns it was possible to determine the quantity and the identity of the crystalline materials present in the enamels. Recrystallized cryolite (Na_3AlF_6), fluorite (CaF_2), and villiaumite (NaF) were found in the fired enamels, cryolite being the most important opacifier in the enamels studied. It was found to recrystallize whenever enough cryolite or sodium silicofluoride was added in the raw batch. The accuracy of the X-ray method was found to be $\pm 1/2\%$ for villiaumite or fluorite and $\pm 1\%$ for cryolite. A calculation of the fluorine unaccounted for showed it to be fairly constant at about 2.8%.

3:00–3:30 P.M.

15. Fundamentals of Color in Porcelain Enamels

By A. I. Andrews and Carl H. Zwermann: Dept. of Ceramic Engineering, Univ. of Iillinois, Urbana, Ill.

Several different colored stains were prepared and added separately to a transparent enamel. The effect of fineness of the enamel, thickness of application, and various heat treatments on the colors obtained with application on white and black undercoats were studied by analyzing the resulting colors with a K. & E. spectrophotometer. The per cent reflectance for each wave-length in the visible spectrum was plotted on special coördinate paper. Microscopic and X-ray examinations were made in order to study the factors producing the color changes noted.

3:30–4:00 P.M.

16. Effect of Furnace Gases on the Physical Properties of Cast-Iron Enamels

By G. H. Spencer-Strong, Porcelain Enamel & Mfg. Co., Baltimore, Md.

Lead-bearing and lead-free cast-iron enamels, applied directly to the iron, and lead-free enamel, applied over ground coats, were fired in normal, low oxygen-high nitrogen, low oxygen-high carbon dioxide, and highly moisture-laden atmospheres. Specimens were tested for resistance to impact and thermal shock. Considerable variation was found in the reaction of the various types of enamels to the conditions of the test.

4:00–4:30 P.M.

17. Factors Influencing Black-Spotting of Cover-Coat Hollow-Ware Enamels

By E. C. Dexheimer: National Enameling & Stamping Co., Inc., Milwaukee, Wis.
G. H. McIntyre: Ferro Enamel Corp., Cleveland, Ohio

A report summarizing a three-year plant study of the problem covering variables of steel and steel preparation and enamels with respect to physical properties, application, and firing.

4:30–5:00 P.M.

18. The Hairline Problem

By W. A. Deringer: Mullins Mfg. Corp., Warren, Ohio

The hairline problem is discussed with relation to the factors which bring about this defect. The factors considered in this paper are the design of the piece, the ground-coat enamel, firing conditions, heat distribution during the firing cycle, weight of application of the ground coat, the metal base, and the cover-coat enamel.

Enamel Division Program (continued)

Hotel Roosevelt: University Room

Thursday Afternoon, March 31, 1938: 2:00 P.M.–5:00 P.M.

2:00–2:30 P.M.

19. The Effect of Enamel on the Strength of Enameling Iron

By A. I. ANDREWS AND E. W. DIETTERLE: Dept. of Ceramic Engineering, Univ. of Illinois, Urbana, Ill.

In this investigation, ground-coat enamel was applied on one and both sides of 26-, 20-, 18-, 10-, and 6-gage enameling stock, and the strengths of the pieces were determined in cross-bending. The results show a great increase in strength for the enameled specimens over that of the stock alone. An increase in the thickness of the enamel increased the strength within limits. The effect on lighter gages was greater than on heavy gages, and the strength is greater when the enamel is under compression than when it is under tension.

2:30–3:00 P.M.

20. A Comparison of the Tensile Strengths of Sheet-Iron Ground-Coat Enamel Glasses

By A. I. ANDREWS AND W. W. COFFEEN: Dept. of Ceramic Engineering, Univ. of Illinois, Urbana, Ill.

The fiber method, developed by Schwalbe, Badger, and Silverman for comparing the tensile strengths of glasses, was used to compare the tensile strengths of sheet-iron ground-coat enamel glasses whose feldspar, borax, and quartz contents varied within workable limits. For purposes of comparison, this method uses that value of the unit stress at failure which exists in a fiber whose fractured surface shows a smooth portion constituting 1% of the total cross-section. For the enamels tested, these values of tensile strength ranged from 30.0 to 32.7 kg. per sq. mm. (42,000 to 46,000 lb. per sq. in.). An increase in quartz or feldspar tended to raise the tensile strength slightly, while an increase in borax tended to lower it slightly, although the total variation was small. From these data, it was concluded that insofar as the enamel strength is concerned, mechanical failures of the enamel, such as chipping, fishscaling, or crazing, could not be aided by variations of the feldspar, borax, and quartz contents of sheet-iron ground-coat enamel glasses within workable limits.

3:00–3:30 P.M.

21. A New Abrasion Test—Results on Enamels and Other Products

By L. SHARTSIS AND W. N. HARRISON: National Bureau of Standards, Washington, D. C.

A test for abrasion resistance has been developed, primarily for use with vitreous enamels, but with promise of applicability to other materials such as glazed ceramic ware, glass, plastics, paints, lacquers, etc. The method of abrasion consists of placing small spherical weights on the face of a flat specimen, confining these materials within a walled-in area and agitating the assembly in a horizontal plane, in such manner that a multi-directional effect is obtained. Water is customarily added to avoid the effect of variations in atmospheric humidity. A commercial screen shaker has been used for this agitation, which is of prescribed character and duration. The specular gloss of the specimen is determined by photoelastic means before and after the test, and the percentage of the original specular gloss retained after the test is taken as the abrasion index. Different vitreous enamels tested by this method have had abrasion index values as high as 82 and as low as 15, as well as various intermediate values.

3:30–4:00 P.M.

22. Fusion Block and Thermal Expansion Tests on Eight Commercial Types of Enamel

By W. N. HARRISON AND D. G. MOORE: National Bureau of Standards, Washington, D. C.

This report concerns the third of a series of studies on eight commercial types of enamel frits. Thermal expansion was determined with the interferometer, using an improved technique. Expansion constants were computed for each enamel, which permit the calculation of expansion behavior in any temperature range up to the lower critical temperature. The lowest expansivities were for a "hard" ground coat and an acid-resisting cover coat for sheet iron. The highest expansivity was for a wet-process, high-lead, cast-iron frit. Softening behavior was observed by the interferometer and the fusion block methods. Both tests placed the frits approximately in the same order. The two most refractory frits had the lowest expansivities, and the least refractory one had the highest expansivity.

4:00–5:00 P.M.

Report of Committees

(*a*) Standardization of Tests
(*b*) Data

Report of Committee on Nominations

Installation of Officers

GLASS DIVISION PROGRAM

Chairman: A. N. Finn, National Bureau of Standards, Washington, D. C.
Secretary: S. R. Scholes, N. Y. State College of Ceramics, Alfred, N. Y.
Program Chairman: L. C. Roche, Maryland Glass Co., Baltimore, Md.

Hotel Roosevelt: Gold Room

Tuesday Afternoon, March 29, 1938: 2:00 P.M.–4:05 P.M.

2:00–2:20 P.M.

1. Annual Report on Glass

By A. Silverman: Univ. of Pittsburgh, Pittsburgh, Pa.

Plans are under way for the preparation of comprehensive annual reports on glass of which the first will cover the science and technology of glass as gathered from various publications such as technical and trade journals. An outline has already been submitted for a WPA project. If this receives government approval, the plan will be carried through as expeditiously as possible. At present, the only annual report on glass which is available is the one which appears as a brief chapter in the Annual Reports of the Society of Chemical Industry of England, inasmuch as the Annual Survey of American Chemistry, which was published by the National Research Council, has been discontinued.

2:20–2:45 P.M.

2. Physical Properties of B_2O_3 Glass

By H. R. Lillie: Corning Glass Works, Corning, N. Y.

A complete understanding of the physical properties of glass and their dependence upon its atomic arrangement is difficult to achieve owing to the complexity of the material. Boric oxide glass may serve as a starting point in such an understanding. Properties reported at this time are viscosity; softening, annealing, and strain points; expansion coefficient; electrical conductivity; density; index of refraction and dispersion; Young's modulus; birefringence constant; and surface tension.

2:45–3:05 P.M.

3. Expansibility Factors for Boron Oxide Glasses

By S. R. Scholes: New York State College of Ceramics, Alfred, N. Y.

Boron oxide, itself a glassy oxide of high expansibility, reduces the expansibility of soda-silica glasses in which it is present in limited amounts, but increases expansibility if it is present in larger amounts. This anomaly is explained on the basis of the formation of sodium borates which are less expansible than sodium silicates. Factors, applied to these compounds and to free B_2O_3 and SiO_2, are developed for the estimation of coefficients of expansion.

3:05–3:30 P.M.

4. X-Ray Diffraction Study of Soda-Boric Oxide Glass

By B. E. Warren and J. Biscoe: Dept. of Physics, Massachusetts Inst. of Technology, Cambridge, Mass.

X-ray diffraction patterns have been made of three samples of soda-boric oxide glass having the following molal compositions: 0.114 Na_2O, 0.225 Na_2O, and 0.333 Na_2O. The patterns were made in an evacuated camera using MoKα radiation monochromated by reflection from rock salt. Radial distribution curves for the three compositions were obtained by Fourier analysis. The first peak is due to the boron-oxygen separation. The distances are 1.37, 1.42, and 1.48A. From the peak areas, the number of oxygens about a boron is found to be 3.18, 3.68, and 3.96. The continuous change both in interatomic distance and number of surrounding oxygens indicates a progressive change in boron-oxygen coördination. In B_2O_3, the coördination is predominantly triangular, each boron bonded to 3 oxygens. With increasing soda content, more of the borons become tetrahedrally surrounded by 4 oxygens. The second peak occurs at 2.40A and is due to oxygens about a sodium and oxygens about an oxygen. The area is well explained by assuming about 6 oxygens around a sodium and 5 to 6 oxygens around an oxygen. The results definitely exclude discrete B_2O_3 molecules.

3:30–3:50 P.M.

5. Some Linear Relations between Composition and Density of Binary Glasses

By J. C. Young and A. N. Finn: National Bureau of Standards, Washington, D. C.

Studies of density-composition relations of soda-silica, potash-silica, and lithia-silica glasses indicate that the relations should be represented by intersecting straight lines. Previously reported data have been reviewed and additional data, based on new glasses, have been added to those reported. Thermal expansion-composition data also show similar linear relations.

3:50–4:05 P.M.

6. Measurement of the Surface Tension of Viscous Liquids

By C. A. Bradley: Corning Glass Works, Corning, N. Y.

The surface tension of liquids of widely differing viscosities has been measured by the maximum bubble-pressure method. With liquids whose viscosities are greater than about 5 poises, a modification in technique is employed which consists in observing the maximum pressure at which a bubble is stable. This is the same technique as employed by Parmelee. The applicability of this method for viscous liquids has been tested by measuring the surface tension at 25°C of a series of solution of rosin in benzyl-benzoate whose viscosities varied from 100 to 2500 poises. The values obtained were within 1% of those observed by the method of capillary rise. The method has been applied to the measurement of the surface tensions of molten glasses whose viscosities varied from 50 to 2500 poises. The precision obtained is about 1%.

Glass Division Program (continued)

Hotel Roosevelt: Gold Room

Wednesday Afternoon, March 30, 1938: 2:00 P.M.–4:05 P.M.

2:00–2:20 P.M.

7. The Law of Annealing of Glass—Quantitative Treatment and Molecular Interpretation (published *Jour. Amer. Ceram. Soc.*, **21** [3] 85-89 (1938))

By N. W. Taylor: Dept. of Ceramics, Pennsylvania State College, State College, Pa.

The reduction of strain birefringence with time in Pyrex-brand chemical resistant glass has been shown to follow the equation,

$$\delta = \delta_m + \delta_{aw}$$

Where δ_m = that part of strain released according to Maxwell's stress law, $-df/dt = k_1 f$.

δ_{aw} = that part released according to the Adams-Williamson law, $-df/dt = k_2 f^2$.

$$\delta_m = \delta_{m_0} e^{-kt}.$$
$$\delta_{aw} = \delta_{aw_0}/(1 + \delta_{aw_0} \cdot At).$$

The molecular nature of stress and strain has been examined, and it has been shown that the Maxwell law is followed when the strain-bearing molecular species (principally the dissociated units) relax independently, without interaction; the Adams-Williamson law is followed when these same species relax by virtue of interaction according to the well-known law for a second order or bimolecular reaction, $-dX/dt = k_2 X^2$. The temperature dependence of each of these two processes is discussed, and an activation energy of 94,000 calories is calculated for the bimolecular interaction process. The theory as outlined appears to be a necessary and sufficient description of the annealing process in silicate glasses or similar materials.

2:20–2:55 P.M.

8. Discussion of Factors Involved in Stress Release

By H. R. Lillie: Corning Glass Works, Corning, N. Y.

An attempt is made to clarify the interpretation of factors involved in the release of stress in glass. Concepts adopted by various authors are seldom at variance with one another; rather, they represent different approaches to the problem and appear as proof of progress when the proper significance is attached to each factor involved.

2:55–3:25 P.M.

9. Effect of Glass Color on the Setting Rates of Glass in the Manufacture of Glass Bottles

By O. G. Burch and C. L. Babcock: Owens-Illinois Glass Co., Toledo, Ohio

It has been observed in the manufacture of bottles of the same size and shape from various colored glasses, such as emerald green and amber, and from the so-called flint bottle glass, that higher machine speeds are usually obtained in the case of the colored glasses. A laboratory test has been devised to measure the cooling rates of several colored and colorless glasses throughout their respective working ranges, which gives results paralleling the speeds obtained in actual bottle manufacture.

3:25–3:45 P.M.

10. Fluorescent Glasses

By W. Weyl: Dept. of Ceramics, Pennsylvania State College, State College, Pa.

(1) A short explanation of the phenomenon of fluorescence is given. Like the color of glasses (absorption spectra), the fluorescence of glasses (emission spectra) is influenced by the composition of the base glass, which is responsible for the intermolecular forces. Strong intermolecular forces usually destroy fluorescence and so it can be explained that many ions, such as neodymium, samarium, cerium, vanadium, copper, manganese, and uranium, show fluorescence when dissolved in glass, whereas they are not fluorescent in their hydrated state in aqueous solutions. (2) In addition to the problem of glass constitution, fluorescence is of special interest for the development of new light sources, taking advantage of the economical gas-discharge tubes by converting the energy of the ultraviolet radiation into visible light. For this purpose a new glass has been developed, using silver atoms, distributed in a glass in a gas-like state as a fluorescent material. On the basis of this "energetic isolation," new types of fluorescent materials can be developed. A method will be described which leads to luminophores in contrast to the long-known type of Lenard phosphores.

3:45–4:05 P.M.

11. A Numerical Evaluation of the Constant in the Gladstone and Dale Equation

By A. N. Finn: National Bureau of Standards, Washington, D. C.

Consideration of the specific refractivities (R) of the glass-forming oxides indicates that R can be expressed, empirically, in terms of ionic radii and hydrogen equivalent-weights of the oxides. In these relations, the oxides fall into two groups, one of which has twice the effect of the other, and from these the constant of the Gladstone and Dale equation can be estimated for each oxide from its molecular weight and atomic radius.

Glass Division Program (continued)

Hotel Roosevelt: Gold Room

Thursday Afternoon, March 31, 1938: 2:00 P.M.–4:05 P.M.

2:00–2:20 P.M.

12. Elastico-Viscous Properties of Certain Potash-Silica Glasses

By Robert Doran and Nelson W. Taylor: Dept. of Ceramics, Pennsylvania State College, State College, Pa.

This work is being carried along the same lines as that on soda-silica glasses by N. W. Taylor and P. S. Dear, *Jour. Amer. Ceram. Soc.*, **20** [9] 296–304 (1937). Comparison will be made of the two glass types.

2:20–2:40 P.M.

13. Permanent Bend in Glass Canes

By H. R. Lillie: Corning Glass Works, Corning, N. Y.

An account is given of canes of glass of known thermal history which were treated under high bending stress for ten weeks at temperatures from 73° to 383°C. The percentage of stress released during the period is computed from a measurement of the curvature remaining after stress removal. The amount of stress release depends upon the kind of glass, the previous thermal history, and the temperature of treatment under stress. During an extended period after stress removal, the curvature was observed to decrease, this decrease being most pronounced in the canes treated at the lowest temperature. Comparisons are made between stress release under these conditions with release observed optically in samples chilled in the ordinary way.

2:40–3:05 P.M.

14. Ring Section Examination of Glass Containers

By V. C. Swicker: Hartford-Empire Co., Hartford, Conn.

Regular periodic examination of cross-sections of glass containers with the polarizing microscope has proved to be a most valuable adjunct to recognized strength tests. The method is described, and its usefulness in the prediction of ware serviceability and as a means of glass quality control is explained.

3:05–3:25 P.M.

15. Relative Solubility of Glass in Acid Solutions as Indicated by Dye Absorption

By E. H. Hamilton and A. N. Finn: National Bureau of Standards, Washington, D. C.

Recent studies on the rate of solution of glass in acid and alkaline solutions have indicated that relative "chemical durability" of glasses could be estimated by the amount of dye adsorbed on treated glass surfaces. The chemical durability is proportional to the amount of "Victoria blue" adsorbed by a glass surface which has been treated with a solution of potassium acid phthalate buffered at p_H 6. Dyed samples of different glasses will be shown.

3:25–3:35 P.M.

16. Outline Study Course on Mechanical Properties of Glassware, with Particular Reference to Glass Containers

By F. W. Preston: Butler, Pa.

A series of eighteen brief memoranda in the methods of approach to this subject, with some discussion of the phenomena involved, is presented. This is intended as an outline for beginners and not as a summary of all that is known to date on the subject.

3:35–4:05 P.M.

17. Report on Committee C-14 of the A.S.T.M.

By G. W. Morey: Geophysical Laboratory, Washington, D. C.

MATERIALS AND EQUIPMENT DIVISION PROGRAM

Chairman: J. E. Eagle, Vitro Mfg. Co., Pittsburgh, Pa.
Secretary: G. C. Betz, Foote Mineral Co., Philadelphia, Pa.
Program Chairman: H. B. DuBois, Consolidated Feldspar Corp., Trenton, N. J.

Hotel Roosevelt: Room G

Tuesday Afternoon, March 29, 1938: 2:00 P.M.–4:00 P.M.

2:00–2:20 P.M.

1. Some Characteristics of Illinois Pottery Clays

By C. G. HARMAN: Dept. of Ceramic Engineering, Univ. of Illinois, Urbana, Ill.

Typical stoneware clays from western Illinois were fired to different temperatures ranging from 950° to 1400°C. Porosity and thermal expansion measurements were made on the fired clays. X-ray diffraction patterns of the fired clays showed the formation of mullite in all of the clays and cristobalite in one of the clays. The temperature of inversion of low to high cristobalite was much lower than usually accepted for the lower limit of this inversion. Data were obtained which indicated that the formation of cristobalite during the firing of clays can be prevented. A limited amount of data was obtained regarding the organic-matter content of the clays, their plasticity, thermal dissociation, and mineralogical constitution. The volume changes of the raw clays during heating were also studied.

2:20–2:40 P.M.

2. Deer Park Pegmatites

By B. C. BURGESS: Tennessee Mineral Products Corp., Spruce Pine, N. C.

A general description is given of the occurrence of pegmatites in Spruce Pine, North Carolina district. Longitudinal and cross-sections are given of the Deer Park pegmatites. Mineral and geological relations are discussed, and the proportional production and chemical analyses are given.

2:40–3:00 P.M.

3. Improvement of Certain Pennsylvania Nonmetallics by Selective Flotation

By D. W. MCGLASHAN, E. C. HENRY, AND N. W. TAYLOR: Dept. of Ceramics, Pennsylvania State College, State College, Pa.

The fundamental principles underlying the froth flotation process will be discussed. These include consideration of the nature of the mineral surfaces based on knowledge of crystal structures, cationic and anionic organic collectors, and modifying or depressing agents, such as p_H, deflocculants, etc. The peculiar problems of the nonmetallics will be described. Some preliminary data on certain Pennsylvania clays will be presented.

3:00–3:20 P.M.

4. Froth Flotation of Talc Ores from Gouverneur, New York

By J. E. NORMAN, R. G. O'MEARA, AND F. X. BAUMERT: U. S. Bureau of Mines, Southern Experiment Station, Tuscaloosa, Ala.

Both fibrous and foliated talc ores from Gouverneur, N. Y., were beneficiated by froth flotation. Three types of ores, talc-tremolite, talc-quartz, and talc-dolomite, were tested. The flotation concentrates from each were enriched in talc. Different flotation reagents were required for the ores. Pine oil was satisfactory for foliated talc, whereas reagents of the amine type were more suitable for fibrous talc. The quartz, moreover, was depressed without additional reagents, but tremolite and dolomite required additional basic or acidic reagents. The results of trade tests on the flotation products from the talc-tremolite ore, which is the most important, were of particular interest. The talc concentrates were a better color and had a higher oil adsorption index which would make them more desirable for the paint trade. A comparison of the feed and flotation products in wall-tile bodies indicated that products depleted in talc would still be suitable for ceramic purposes.

3:20–3:40 P.M.

5. Ceramic Uses of Volcanic Ash

By NORMAN PLUMMER: State Geological Survey of Kansas, Lawrence, Kans.

Volcanic ash has been successfully used both in lead and lead-alkali glazes, replacing the feldspar and a portion of the flint, and constituting in some glazes up to 50% of the total weight of the raw materials. Both fritted and raw glazes were used for the tests, and the maturing temperatures range from cones 08 to 03 for the greater number. Volcanic ash proved equally successful in enamels, a few higher temperature glazes, and in glass batches. Colorless glazes or glass can not be obtained because of the high iron content. Formulas for the volcanic ash used have the following range:

K_2O	0.5564–0.2107			
Na_2O	0.3113–0.6374	Al_2O_3	0.9572–1.244	SiO_2 9.80–10.52
CaO	0.0155–0.1194	Fe_2O_3	0.0700–0.079	
MgO	0.1167–0.0325			

3:40–4:00 P.M.

6. Distribution of Volcanic Ash

By KENNETH K. LANDES: Kansas State Geological Survey, Lawrence, Kan.

Volcanic ash, or pumicite, occurs in scattered deposits over the Great Plains, especially in Nebraska, Kansas, and Oklahoma. It is also found in some of the Rocky Mountain and Pacific Coast states. At present, deposits in Kansas, Oklahoma, Nebraska, and California are being exploited. Most of the ash is a product either of late Tertiary, Pleistocene, or recent volcanoes. The source of the Great Plains ash is believed to be the Capulin group of volcanoes in northeastern New Mexico.

Materials and Equipment Division Program (continued)

Hotel Roosevelt: Room G

Wednesday Afternoon, March 30, 1938: 2:00 P.M.–4:20 P.M.

2:00–2:20 P.M.

7. Temperature Measuring Cones (published *Jour. Amer. Ceram. Soc.*, **21** [3] 98–101 (1938))

By R. F. REA: Denver Fire Brick Co., Denver, Colo.

A series of pyrometric cones that measure temperature independent of the rate of heating has been developed. These cones are mixtures of inorganic salts and melt congruently. Melting-point data are presented for the three binary systems, $MgSO_4$–Li_2SO_4, K_2SO_4–KBr, Na_2SO_4–NaBr.

2:20–2:40 P.M.

8. Effect of Atmospheric Exposure on Unfired Ceramic Bodies

By J. O. EVERHART AND RALSTON RUSSELL, JR.: Engineering Experiment Station, Ohio State Univ., Columbus, Ohio

The effect of storage conditions on the unfired properties of seven representative ceramic bodies is reported in the paper. These bodies were thoroughly dried and stored in desiccators, open air, and damp rooms for various periods of time. The effects of these treatments on volume, weight, and transverse and compressive strengths were observed. One surface clay showed complete loss of strength after a few hours open-air exposure. Other bodies were affected to a lesser extent but all suffered somewhat. Bodies with low organic content may be restored approximately to their original condition by redrying. Those high in organic content can not.

2:40–3:00 P.M.

9. Pulverized Coal Offers Opportunities to the Ceramic Industry

By A. W. GAUGER AND H. W. NELSON: School of Mineral Industries, Pennsylvania State College, State College, Pa.

Pulverized coal has proved to be an efficient and economical fuel for steam raising and for certain heating and firing processes. The ceramic industry has long used pulverized coal in firing cement and lime kilns. A highly successful kiln using this fuel for the production of chemical lime is described. While fluid fuels are generally used in many ceramic processes to obtain proper conditions of heat distribution and control, furnace atmosphere, and time-temperature relationships, pulverized coal offers possibilities of fuel economics worthy of consideration and investigation by ceramic industries in many areas. Several possible applications of this fuel to the manufacture of ceramic products are presented.

3:00–3:20 P.M.

10. Adapting Hydraulics to the Ceramic Industry

By F. J. WRIGHT: The Denison Engineering Co., Columbus, Ohio

A review is given of the early stages of hydraulics and its entry into the ceramic field: development and additional uses in kiln and leer operation, interlocked circuits, haulage systems, filter-press jacks, forming presses, molding presses, and other hydraulic machinery used in the manufacture of ceramic products. Some large hydraulic installations and the variable volume radial piston pump, which has become the answer to many press problems, are also described.

3:20–3:40 P.M.

11. A New Pumping Principle

By E. B. GEORGE: Robbins & Meyers, Inc., Springfield, Ohio

The evolution of the art of pumping is discussed, and a comparison is made of the fundamental principles used in domestic and industrial pumping, *i.e.*, plunger and pistons, centrifugal, turbine, rotary, gear, and screw principles. An account is given of the incentive for the discovery of the Moineau principle of pumping. The Moineau (Moyno) pump can not be properly classified in any classification, but physically it utilizes characteristics of each except the centrifugal and turbine. It is described as follows: (*a*) it has a suction like a cylinder and a piston of infinite length; (*b*) the internal working parts consist of driven and stationary parts not unlike the ring gear and piston, but in form they are entirely different;

(*c*) the lengthwise translation of liquid is similar to the screw pump, "a liquid jackscrew"; and (*d*) the seal between high and low pressures is accomplished by rolling contact and liquid adhesion. The Moineau principle is technically described as (*a*) a single-thread worm of double pitch, meshing with and turning in a double-threaded gear or helix of single pitch; (*b*) the cross-section area of displacement is dependent upon rotor diameter and eccentricity of rotating assembly with respect to stator; (*c*) in volume per revolution, the integrated volume of the cross-section area of the helix is displaced; and (*d*) the mathematical relationship of the three fundamentals of construction are E = eccentricity of rotor orbit; D = diameter of rotor and width of stator opening; and P_s = pitch of stator helix = $2\ Pr$ = rotor pitch. In the resultant characteristics of operation, the working elements serve as a check valve between the high- and low-pressure sides; the pump is valveless in construction; the passages through the working elements are large in proportion to the diameter of impeller or rotor; the velocity of liquid flow is extremely low (minimum erosive action); the displacement is positive; the application and use of power is efficient; the assembly consists of few working parts; and replacement of parts is simple and effective in producing a new pump. The problems of liquid translation are water; homogeneous liquids, lubricating and nonlubricating; solids in suspension, granular or crystal emulsified (pulps), abrasive (slurry), and nonabrasive; volume *vs.* pressure; and viscosities *vs.* temperatures. There is also a discussion of the point where the use of pumps leaves off and that of conveyers begins.

3:40–4:00 P.M.

12. Dry Mixing

By F. A. Fix: Lancaster Iron Works, Inc., Lancaster, Pa.

The author will show what is being done in the field of electrical porcelains, tile, electrical refractories, and plastic bodies.

4:00–4:20 P.M.

13. An Economic Study of Possible Locations for Sanitary-Ware Plants in Tennessee

By G. I. Whitlatch: Tennessee Division of Geology, Nashville, Tenn.

(1) Large tonnages of raw materials necessary to the manufacture of high-grade ceramic ware are annually produced in the South, but this area has developed only a minor industry to use these resources. The bulk of these raw materials is shipped to northern manufacturing centers where they are converted into finished ware and are then, in part, returned for sale to southern markets. Thus, the southern consumer, in buying such northern-made ware, is forced to pay prices that include charges for long freight hauls both on the raw materials and the finished product. This highly uneconomic situation is becoming more and more intolerable to southern consumers, for they naturally prefer home-made products and the lowest prices commensurate with reasonable quality. The remedy demanded, therefore, is establishment of southern ceramic industries capable of supplying these markets' needs with products made largely of native raw materials. Of these needed industries the present paper considers sanitary-ware manufacture to be especially opportune for development. (2) Tennessee is a particularly favorable location for the establishment of a southern sanitary-ware industry, chiefly because of its central location with respect to sources of the necessary raw materials and because of ready accessibility to most of the principal southern and southwestern markets. Assemblage costs, based on several sanitary-ware body formulas, are shown in detail for six possible plant locations in the State. Fuel costs, including those of coal, natural and artificial gas, fuel oil, and electricity, and industrial rates on electric power and water are also given in detail, with accompanying chemical analyses of the available ceramic coals and water supplies. Other factors related to manufacturing costs that are considered include tax legislation and tax rates; labor supply and efficiency, labor laws, and prevailing wage rates in typical manufacturing industries of the State; banking facilities; climate; and general living conditions, with illustrative rental costs. (3) The current maintenance of numerous wholesale branch offices in the South by several northern sanitary ware manufacturers is considered indicative of a supporting demand for this type of ware, but statistical data are also cited to show the approximate scope of the present market and the most favorable sales price range. Attention is further directed to an awakening interest in the southern states in improved sanitation and the future favorable effect of this factor on the market demand for sanitary ware. Shipping facilities from Tennessee localities to southern markets are fully considered, and freight charges to these markets from the principal northern pottery centers and from Tennessee points are compared.

For General Session on Constitution of Clays, see p. 90.

REFRACTORIES DIVISION PROGRAM

Chairman: H. M. Kraner, Bethlehem Steel Co., Bethlehem, Pa.
Secretary: S. F. Walton, Exolon Co., Blasdell, N. Y.
Program Chairman: J. B. Austin, Research Lab., U. S. Steel Corp., Kearny, N. J.

Hotel Roosevelt: Room E

Tuesday Afternoon, March 29, 1938: 2:00 P.M.–4:30 P.M.

2:00–2:30 P.M.

1. Some Relationships between Various Physical Properties of Insulating Refractories

By Carl E. Curtis: Simonds Worden White Co., Dayton, Ohio

Data concerning the various physical properties of several brands of insulating refractories are plotted together. From the resulting figures, conclusions are drawn concerning the relationships between the various properties. In connection with the permeability data, a specimen holder especially adapted for use in determining the permeability of insulating brick is described.

2:30–3:00 P.M.

2. Shrinkage of Insulating Refractories

By S. M. Phelps and E. C. Petrie: American Refractories Institute, Pittsburgh, Pa.

This paper presents the results of an extensive test method study for the purpose of determining the shrinkage of insulating materials to be used as exposed linings in furnaces. Test methods and data are given for a number of brands tested in various procedures employing soaking heat and as sections of the furnace wall or the panel test. There are also presented the effects obtained from reducing gas atmospheres.

3:00–3:30 P.M.

3. Practical Insulation of Ceramic Furnaces

By J. C. Crawford, Jr.: Johns-Manville Corp., 22 East 40th St., New York, N. Y.

An analysis is presented of the economical application of insulation to various types of ceramic furnaces, including a discussion of the types of insulation, methods of application, and means for determining the economical thickness.

3:30–4:30 P.M.

4. Heat and Its Control (Sound Movie)

By J. C. Crawford, Jr.: Johns-Manville Corp., 22 East 40th St., New York, N. Y.

(1) This talking motion picture presents for the first time an actual visualization of the story of heat, from the time man worshipped the sun as his only source of heat and light, through the development of the steam engine, the discovering of the true nature of heat, to present-day methods of development and manufacture of materials designed for heat conservation. (2) Actual laboratory demonstrations, animated drawings, and shadowgraphs are used in this talking motion picture to help visualize what heat is and to illustrate heat transfer by radiation, convection, and conduction. (3) Animated drawings are used to demonstrate molecular activity, the passage of heat through a boiler wall, and how insulating materials resist the passage of heat. Other animated drawings and laboratory demonstrations are used to explain the phenomenon of thermal conductivity and the reasons for the vast difference in the conductivity of various substances. The same effective method is employed to visualize radiant heat energy. An interesting series of shadowgraphs enables one *to see* the air currents set up by heat in so-called dead-air spaces as well as the convection currents set up by flames, heated pipes, and the like. (4) Man's first efforts toward the scientific conservation of heat, the activity in a modern heat research laboratory, how new materials for conserving heat are developed, how they are manufactured, and methods of utilizing these materials in various industries are pictured in detail. (5) From beginning to end "Heat and Its Control," while picturing a most complete story of heat, emphasizes those phases of this broad subject which are of essential importance to men in industry who have to depend upon heat as one of the vital factors in their production operations.

Refractories Division Program (continued)

Hotel Roosevelt: Room E

Wednesday Afternoon, March 30, 1938: 2:00 P.M.–4:20 P.M.

Discussion of Basic Refractories

2:00–2:20 P.M.

5. Absorption of Magnesia by Chromite Spinel

By L. J. Trostel: General Refractories Co., Baltimore, Md.

The expansion of chrome ore-magnesite mixtures is attributed to solid solution of magnesia in the spinel component of the ore. This conclusion is substantiated by measurements of the density, index of refraction, and lattice width, before and after exposure to magnesia.

2:20–2:50 P.M.

6. Chrome Magnesite Brick for Open-Hearth Furnaces

By J. H. Chesters: Central Research Dept., United Steel Companies Ltd., Stocksbridge, near Sheffield, England

T. R. Lynam: The Oughtibridge Silica Firebrick Co., Ltd., Oughtibridge, near Sheffield, England

The attempt to replace silica brick in open-hearth furnaces by more refractory basic brick has raised a number of interesting problems. Thus chrome-magnesite brick, although much improved in their physical properties, are subject to certain limitations in service, *e.g.*, the bursting which occurs when they become impregnated with iron oxide. The properties of a number of British and Continental chrome-magnesite brick are given, including data regarding the factors determining their thermal shock and bursting resistance. The influence of iron oxide on the melting point of chrome-magnesite brick is also discussed. The results obtained, both with limited trials and with complete furnaces built from chrome-magnesite brick, are described, and an attempt is made to analyze the ultimate causes of failure. Both laboratory and service tests suggest that the bursting which accompanies iron-oxide absorption is responsible for a considerable part of the damage, but that this can be overcome, at least in part, by a modification of the brick batch. With hot metal furnaces, where the concentration of iron oxide is lower and shut-downs less frequent, the life obtained with chrome-magnesite brick is considerably greater.

2:50–3:20 P.M.

7. Development of Spalling Resistance in Magnesia-Chrome Brick

By J. W. Craig: Canadian Refractories, Ltd., Montreal, Canada

The problem of utilizing magnesitic-dolomite rock for basic refractory brick has led to the development of products of relatively high spalling resistance. It was first necessary to manufacture a satisfactory dense magnesitic clinker and to solve the problem of dusting or formation of gamma dicalcium silicate and of lime combination stable against hydration. The lime-silica ratio and iron addition are most important. Commercial manufacturing difficulties of excessive linear shrinkage and plastic flour were largely overcome by chrome-ore additions with optimum of 30%. Spalling resistance is accomplished primarily (1) by using coarse chrome and finer magnesitic clinker (tables show the effect on spalling resistance by variation in the amount and size of each grain-size fraction of chrome and magnesite); (2) spalling resistance is achieved, but properties of the brick are different for other types of magnesite and chrome from different sources; and (3) spalling resistance is further improved by high density secured by grain sizing and method of manufacture and by higher firing temperature and longer soaking. Reactions are discussed in the systems $MgO–Fe_2O_3$, $CaO–SiO_2$, $CaO–Fe_2O_3$, and $MgO–SiO_2$ from chrome ore plus CaO. Tables are shown of chemical analysis, screen analysis, and properties of fired brick. Photographs are shown of brick and thin sections.

3:20–3:50 P.M.

8. Nonhydrating Lime-Bearing Brick

Basic Bricks (Overseas), Ltd.

A general description is given of the occurrence of the raw materials and the method of processing them. There is an account of some results obtained in practice in steelmaking furnaces.

3:50–4:20 P.M.

9. The Thermochemistry of Olivine in the Manufacture of Forsterite Refractories

By R. L. Stone: Dept. of Ceramic Engineering, University of North Carolina, Raleigh Unit, Raleigh, N. C.

A review of the properties of forsterite refractories and the causes of their failure are presented. The main cause of failure is incomplete conversion of the impurities as shown by photomicrographs. Photomicrographs also show the several stages of breakdown of the crude olivine and the stages of conversion to forsterite as dependent upon temperature. The relation of the thermochemistry of the olivine to the manufacture of high-grade forsterite refractories is given.

Refractories Division Program (continued)

Hotel Roosevelt: Room E

Thursday Forenoon, March 31, 1938: 10:00 A.M.–12:00 M.

Session on Slag Attack

10:00–10:30 A.M.

10. Influence of Fluidity, Hydrodynamic Conditions, and the Solvent Action of Slag on the Destruction of Refractories at High Temperature

By K. Endell, R. Fehling, and R. Kley: Technische Hochschule, Berlin, Germany

Two different methods for determining viscosity in the range 0.1 to 10^5 c.g.s. units (poises) at temperatures up to 1650°C are described, and some results on slags and glasses are given. Attack on any given refractory at a given temperature increases with the fluidity of the slag. Researches with hydrodynamic models show that the velocity of flow and film thickness depends more on viscosity of the slag than on angle of inclination. A new interpretation of the solvent action of slags on refractories together with thermodynamic considerations and measurements of viscosity permits a general mathematical treatment of the complicated changes occurring during slagging. Slag attack may be lessened effectively by choosing a refractory of low solubility and by cooling of the wall to a temperature of 50°C over the melting point of the slag.

10:30–11:00 A.M.

11. Simulative Service Tests for Boiler-Furnace Slags

By T. A. Klinefelter: National Bureau of Standards, Washington, D. C.

The simulative service tests in use at the present time have not proved satisfactory. The reasons for this statement are presented.

11:00–11:30 A.M.

12. Influence of Alumina Coatings on Resistance of Refractories to Slag Action

By H. G. Schurecht: Ceramic Experiment Station, New York State College of Ceramics, Alfred, N. Y.

Aluminum coatings applied to refractories were found to increase greatly their resistance to slag action.

11:30 A.M.–12:00 M.

13. Effect of Fluxes on Cupola Linings

By C. K. Donoho and J. T. MacKenzie: American Cast Iron Pipe Co., Birmingham, Ala.

The authors review briefly the mechanism and types of attack of cupola linings with particular reference to chemical attack and factors affecting the composition of slags. Methods of testing refractories for cupola service are outlined, and refractories found to be satisfactory for severe service as well as suitable lining procedures are discussed. Operating conditions and fluidity of slags are revealed as major factors determining degree of attack.

Refractories Division Program (continued)

Hotel Roosevelt: Room E

Thursday Afternoon, March 31, 1938: 2:00 P.M.–4:20 P.M.

2:00–2:20 P.M.

14. The Linear Thermal Expansion of "Beta-Alumina"

By J. B. Austin: Research Laboratory, U. S. Steel Corp., Kearny, N. J.

An attempt to determine the linear thermal expansion coefficient of a sample of "beta-alumina" containing 4.47 % K_2O and 1.03 % Na_2O was unsuccessful because the expansion was irregular and not reproducible. On successive heatings, the expansion approached more and more closely that of alpha alumina (corundum). This observation, together with the fact that the fused silica parts of the expansion apparatus were badly etched during the measurements apparently by alkali given off by the sample, gives further support to the view that "beta-alumina" is not an allotropic form of pure alumina but is an alkali aluminate.

2:20–2:50 P. M.

15. Beryllium Oxide

By H. E. WHITE AND R. M. SHREMP: Lava Crucible Co. of Pittsburgh, Zelienople, Pa.

This interesting and somewhat rare material forms, curiously enough, few mineralogical combinations although many binary and some ternary diagrams have been plotted. The apparent stable crystalline formation at relatively low temperature is interesting. This is confirmed by specific gravity determinations on the oxide fired at different temperatures and on the electrically fused oxide both by the writers and others. Thermal expansion of the electrically fused beryllium oxide and on bars of the oxide fired at lower temperatures is also very close. The electrical resistivity is higher than magnesia and alumina. The thermal resistivity appears to be greater than magnesia, alumina, and zircon. The hardness is 9.

2:50–3:20 P.M.

16. Some Properties of Air-Setting Refractory Mortars (Wet Type).

By R. A. HEINDL: National Bureau of Standards, Washington, D. C.

Twenty mortars of the type marketed in the wet condition were subjected to various tests for purposes of obtaining data which could be incorporated in a Federal Specification for this commodity. After having been in storage for some months, it was noted whether the solids in the mortars had separated from the liquid, whether the solids and liquid could be readily recombined, and whether or not the mortar had a satisfactory working consistency. The water-loss at 105°C, alkali content, sieve analysis, pyrometric cone equivalent, and setting time were determined. A machine was developed to simulate mechanically the motion of the mason's trowel, and all mortars were tested for ease of spreading on fire brick for four different periods of time. After drying on the brick, it was noted whether the mortars had cracked and pulled from the brick. The transverse strengths at ordinary temperatures of the unheated materials, as well as those of the materials after having been heated at several temperatures, were determined. The mortars were tested for bonding strength after similar heat treatments.

3:00–3:50 P.M.

17. Effect of Sodium Aluminate on Thermal Expansion of Refractory Clays

By W. R. MORGAN: Dept. of Ceramic Engineering, Univ. of Illinois, Urbana, Ill.

C. L. THOMPSON: Harbison-Walker Refractories Co., Pittsburgh, Pa.

The experiments show the effect of 1% and 2% of sodium aluminate on the thermal expansion of Missouri semiflint clay and on mixtures of Florida clay with fine quartz flint after one and two firings to cone 13 in a commercial kiln. The expansion characteristics were determined over the range 20° to 850°C by the interferometer method.

3:50–4:20 P.M.

18. Expansion Characteristics of Kyanite and Kyanite-Clay Mixtures When Heated

By GORDON R. POLE AND D. G. MOORE: Dept. of Chemical Engineering, T.V.A., Wilson Dam, Ala.

Using kyanite of 90 to 95% purity, studies were made of the effect of grain sizing on the expansion of raw kyanite and kyanite-clay bodies when heated. These bodies were made both by dry pressing and by wet casting. Expansions of the test pieces were measured by means of an "Ames" dial-type dilatometer apparatus, while the pieces were heated in a furnace. Since the expansion resulted from decomposition of the kyanite, it was inferred that the rate of linear expansion of the kyanite was a satisfactory measure of the rate of decomposition. Porosities and apparent specific gravities were determined on the test pieces before and after heating. The relation of grain size and clay content to the expansion and increase in porosity was established quantitatively, and curves were plotted showing these relationships. Cast pieces had approximately the same expansion but lower porosity, when compared with dry-pressed pieces of the same grain size and clay content. The results indicated that dense bodies could be obtained by using finely ground kyanite. Utilizing the information obtained in these studies, kyanite insulating brick were made from mixtures of kyanite, clay, and sawdust in various proportions. The physical properties of these insulating brick, such as porosity, bulk, specific gravity, P.C.E., crushing strength, and shrinkage at cone 30 were determined. The insulating brick compared favorably with commercial products.

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STRUCTURAL CLAY PRODUCTS AND TERRA COTTA DIVISIONS JOINT PROGRAMS

Structural Clay Products Division Officers

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Chairman: H. E. Davis, Federal Seaboard Terra Cotta Co., South Amboy, N. J.
Secretary: D. F. Albery, Edward Orton, Jr., Ceramic Research Foundation, Columbus, Ohio
Program Chairman: H. E. Davis

Hotel Roosevelt: Room D

Tuesday Afternoon, March 29, 1938: 2:00 P.M.–4:20 P.M.

2:00–2:20 P.M.

1. The Improvement of Stiff-Mud Clays through p_H Control

By G. J. Barker and Emil Truog: Dept. of Mining and Metallurgy, Univ. of Wisconsin, Madison, Wis.

Clays, when given a correct alkali treatment, show a marked improvement in working qualities. They become more plastic, require less power to extrude the clay through the die, and, when dried, have greater strength and are less pervious to water. The tendency of clays to laminate is reduced. The fired ware is stronger and has a lower moisture absorption. Both acid and calcareous clays are susceptible to improvement by this process. The amount of reagents must be carefully controlled by p_H measurement for best results. The method of testing for p_H and the limits within which the two type clays must be held are described.

2:20–2:40 P.M.

2. Relation of Activated Contact of Flux Content of Ceramic Materials to Acceleration of Vitrification, Toughness, and Other Characteristics

By H. R. Straight: Straight Engineering Co., Adel, Iowa

A method is described of the acceleration of vitrification of the fired ware which increases the final strength and the toughness and improves the physical characteristics by the prevention of air checking, warping in the firing process, and crazing in cooling. The experience on cost savings gained in the writer's plant is given where the method has been roughly applied to prove the theory.

2:40–3:00 P.M.

3. Some Experiments in Zinc Flashing of Red Face Brick

By C. Major Lampman and H. G. Schurecht: Ceramic Experiment Station, New York State College of Ceramics, Alfred, N. Y.

The effect of compositions of clays on their ability to take a zinc flash was studied in three different commercial kilns. The color obtained was found to be dependent upon (1) the impurities in the bodies, (2) the temperature of firing, (3) the vitrification of the body, and (4) the kiln atmosphere.

3:00–3:20 P.M.

4. Use of New York State Clays in Masonry Mortars

By H. G. Schurecht and M. Corbman: Ceramic Experiment Station, New York State College of Ceramics, Alfred, N. Y.

The substitution of New York State clays for lime in brick masonry mortars (1) increased their strength, (2) increased their bonding power, (3) improved their resistance to frost action, and (4) made the mortar work better.

3:20–4:00 P.M.

5. Relation between Water Content of a Clay and Its Flow Pressure

By R. T. Stull and P. V. Johnson: National Bureau of Standards, Washington, D. C.

The pressures to produce mobility of clay with different water contents were determined for a Maryland brick clay, a Georgia kaolin, and a Kentucky ball clay. The water contents ranged from 18 to 34% for the Maryland clay, 24 to 41% for the kaolin, and 26 to 52% for the ball

clay, and the resulting pressures ranged from 8 to 400 lb./in.^{2}. The curves obtained from the plotted data were hyperbolic in character of the form

$$(w - a)^m (P + b) = K.$$

Where w = per cent water content of clay
P = pressure in lb./in.^{2}
a, b, m, and K = constants for a definite clay.

The asymptote "a" represents the per cent of mechanical water with which the clay must be imbued before it becomes amenable to flow at the theoretical infinite pressure. At zero applied pressure the water content is

$$w = \left(\frac{K}{b}\right)^{1/m} + a$$

when the clay will show mobility under an increment of applied pressure.

4:00–4:20 P.M.

6. A Recirculating Radiated Waste-Heat Drier Operating under Controlled Humidity and Temperature

By H. R. Straight: Straight Engineering Co., Adel, Iowa

A recently developed method is described of building up temperature and humidity in the receiving end, with aeroplane-type propellers. The air in the receiving end is continually recirculating over reheating surfaces so as to give an updraft over reheating surfaces and a downdraft through the green ware in which the temperature is being built up under high humidity. Another method of circulation may be used with like propellers differently arranged in the drier section by which combined longitudinal and vertical recirculating is maintained to give a general effect in movement of reheating air past radiating surfaces and a general downward movement through the ware being dried. The drier described is adapted to cars or pallets on which hollow-ware, brick, or heavy units are dried.

Structural Clay Products and Terra Cotta Divisions Joint Programs (continued)

Hotel Roosevelt: Room D

Wednesday Afternoon, March 30, 1938: 2:00 P.M.–4:00 P.M.

2:00–2:20 P.M.

7. Direct Coal-Fired Tunnel Kiln for Heavy Clay Products

By Philip Dressler: Swindell-Dressler Corp., Pittsburgh, Pa.

This paper discusses a new type of direct-fired tunnel kiln for firing brick and other heavy clay products, utilizing coal as a fuel with a correspondingly low cost of firing.

2:20–2:40 P.M.

8. Should the Downdraft Periodic Kiln Be Round or Rectangular?

By W. D. Richardson: 366 King Ave., Columbus, Ohio

The paper contains a discussion of some facts in the history of the introduction, development, and extensive use of downdraft periodic kilns in the United States. The advantages and disadvantages of the round kiln and the rectangular kiln are cited. The chief defect of the rectangular kiln is the frequent need of repairs in the crown. This may be eliminated by the use of the durable flat suspended arch. The latest developments of the rectangular kiln are described and illustrated.

2:40–3:00 P.M.

9. Correlation of Electrical and Thermal Properties of Building Brick (published *Jour. Amer. Ceram. Soc.*, **21** [3] 79–85 (1938))

By J. Stuart Johnson: Dept. of Electrical Engineering, School of Mines and Metallurgy, Univ. of Missouri, Rolla, Mo.

(1) A relationship has been found to exist between the electrical and thermal conductivities of certain ceramic materials. This relation appears to be both a direct and an approximately linear function of the porosity of the material and, for the materials used, independent of chemical composition. (2) Current-voltage relations bear out the generally accepted assumption that solid, nonmetallic dielectrics, such as ceramic materials, exhibit electrical conductivity by virtue of a movement of ions. (3) Current-time relations indicate that the materials used in this study exhibited an appreciable polarization current, the magnitude and time of decay of which were closely associated with the porosity. (4) The latter, time of decay, is of particular interest. From these observations it is evident that the effective direct-current resistance of a ceramic insulator may not be its final steady-state resistance but some much lower value.

3:00–3:20 P.M.

10. Progress in Pre-Stressing Structural Clay Products

By F. O. Anderegg: Owens-Illinois Glass Co., Newark, Ohio

During the past year lightweight units have been developed which readily assemble into roofing members having lengths up to 12 feet. With proper precautions as to

mortar composition and to curing the mortar under compression, which is easily done by means of the pre-stressing rods, excellent strengths and notable stiffness are obtained. Proper distribution of bearing for the ends of the rods must be provided. These particular members being provided with tongue and groove construction fit nicely together and form a smooth surface for the final roofing after a little grout has been applied to fill up the longitudinal joints. These roofs are very resistant to corrosive fumes or condensation, but the latter is considerably reduced by the insulating value of the tile. Heavy-duty floors are being assembled from heavier tile, which have the necessary compressive strength to permit heavy pre-stressing. Similar construction of walls is a logical step as well as the assembly of still larger units of lightweight clay products for factory fabricated buildings.

3:20–3:40 P.M.

11. Paving Brick and Paving Brick Research

BY H. Z. SCHOFIELD: Research Bureau, National Paving Brick Assn., Washington, D. C.

A report of progress on the development and use of nonexuding fillers for brick pavements is given. A description is given of laboratory and service tests, both installed and planned, of reinforced brick pavements.

3:40–4:00 P.M.

Business Session

All Types of Circular and Straight Tunnel Kilns

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WHITE WARES DIVISION PROGRAM

Chairman: R. F. Geller, National Bureau of Standards, Washington, D. C.
Secretary: J. W. Hepplewhite, Edwin M. Knowles China Co., Newell, W. Va.
Program Chairman: Karl Schwartzwalder, AC Spark Plug Co., Flint, Mich.

Hotel Roosevelt: Grand Ball Room

Tuesday Afternoon, March 29, 1938: 2:00 P.M.–5:00 P.M.

2:00–2:30 P.M.

1. Fundamental Properties of Nepheline Syenite

By C. J. Koenig: Engineering Experiment Station, Ohio State Univ., Columbus, Ohio

Fundamental properties of nepheline syenite, such as thermal expansion and fusion characteristics, are given. Test specimens of twelve bodies, comprising various flux combinations of nepheline syenites and potash feldspars with talc, whiting, magnesium carbonate, and pyrophyllite, were fired to seven different cones. The firing linear shrinkage curves of combinations of nepheline syenite with the test materials are somewhat similar to such combinations with potash feldspar except that the syenite combinations are active at lower temperatures. Sintering ranges of nepheline syenites are longer than those of potash feldspar. This is explained thermochemically.

2:30–3:00 P.M.

2. Influence of Grain Size of Nepheline Syenite on Physical Properties of Porcelain

By C. J. Koenig: Engineering Experiment Station, Ohio State Univ., Columbus, Ohio

Nepheline syenite ground to near pottery-grade fineness was air-separated into coarse, medium, and fine divisions. When introduced into a porcelain body, the fine division afforded a longer vitrification range, lower warpage, increased mechanical strength, and lower coefficient of expansion than the coarse division. Photomicrographs of body structures are included.

3:00–3:30 P.M.

3. Use of Nepheline Syenite in Sanitary Porcelain

By C. J. Koenig: Engineering Experiment Station, Ohio State Univ., Columbus, Ohio

The results obtained with the use of nepheline syenite in sanitary porcelain are promising. By introducing nepheline syenite in reduced amounts to replace potash feldspar, a longer vitrification range is afforded which results in lower warpage. The mechanical strength and thermal expansion of such bodies compare favorably to those using potash feldspar as the flux. Ware fluxed with nepheline syenite has a steel-like ring, the pitch being higher than the regular ware. A pure-tone electrical machine was used to classify the various pitches. An oscillograph was used to determine fatigue. Photomicrographs of bodies and glazes are included.

3:30–4:00 P.M.

4. Pyrometric Properties of Spodumene-Feldspar Mixtures

By J. E. Boyd, Jr.: Tennessee Mineral Products Corp., Spruce Pine, N. C.

An experimental study is reported on pyrometric properties of mixtures of potash feldspar, soda feldspar, and spodumene. Numerical and graphic data show that the addition of spodumene to the feldspars up to 20% lowers the P.C.E. of the mixtures rapidly. As spodumene is increased above 40%, the P.C.E. of the mixtures increases rapidly. By means of a triaxial diagram, a considerable area is shown with P.C.E. values 6 to 7 cones below those of the feldspars.

4:00–4:30 P.M.

5. Some Notes on Pyrophyllite as an Electrical Insulator

By F. J. Stevens: American Lava Corp., Chattanooga, Tenn.

Physical data in connection with several fired pyrophyllite bodies are presented. This covers modulus of rupture, compression strength, dielectric constant, loss factor, specific gravity, porosity, and dielectric strength data. Information concerning shrinkage between the green and fired state is also given.

4:30–5:00 P.M.

6. Some Pyrochemical Properties of Pyrophyllite

By C. W. Parmelee and L. R. Barrett: Dept. of Ceramic Engineering, Univ. of Illinois, Urbana, Ill.

The effect of heat upon two samples of pyrophyllite from North Carolina and one from Austria was investigated. The test pieces, formed from the semidry ground material by high pressure, were fired in the range 400° to 1400°C and the weight losses, volume and thermal changes, optical properties, and lattice structure were studied. Pyrophyllite loses its water of constitution between 350° and 850°C without an endothermic effect or destruction of the lattice. The characteristic structure is lost between 1000° and 1100°C. One of the products is mullite. The effect of boric oxide, phosphorus pentoxide, vanadium pentoxide, and tungstic oxide introduced as accelerators was observed. Vanadium pentoxide and tungstic oxide promote the formation of mullite.

White Wares Division Program (continued)

Hotel Roosevelt: Grand Ball Room

Wednesday Afternoon, March 30, 1938: 2:00 P.M.–4:30 P.M.

2:00–2:20 P.M.

7. Correlation of Laboratory with Service Tests for Pottery Plaster

By J. F. McMahon and H. G. Schurecht: Ceramic Experiment Station, New York State College of Ceramics, Alfred, N. Y.

Service tests were conducted on jigger and casting molds with twelve different brands of plaster. These service tests were compared with certain laboratory tests.

2:20–2:40 P.M.

8. Evacuation of Pottery Plaster

By R. G. Cowan and F. P. Hall: Onondaga Pottery Co., Syracuse, N. Y.

The description is given of the method, equipment, and results of plant trials on evacuation of pottery plaster for use in jigger molds and in casting molds.

2:40–3:00 P.M.

9. Plastic and Drying Behavior of Certain Clays as Influenced by Electrolyte Content

By E. C. Henry and A. C. Siefert: Dept. of Ceramics, Pennsylvania State College, State College, Pa.

Electrodialyzed samples of several clays were saturated at p_H 7 with various cations. Measurements were made to determine the effect of these cations on the workability of the clays and on their drying behavior (amount of shrinkage and rate of water loss).

3:00–3:20 P.M.

10. The Quadrant-Chart Type of Nomograph as Applied to Clay Slips (published *Jour. Amer. Ceram. Soc.*, **21** [3] 101–103 (1938))

By J. A. Pask: Dept. of Ceramic Engineering, Univ. of Illinois, Urbana, Ill.

An example of the quadrant-chart type of nomograph for "changing the concentration of a water-solid mixture to another desired concentration of 100 cubic centimeters volume" and a general summary of the mechanics of construction of this form of graphical solution are presented.

3:20–3:40 P.M.

11. Metallizing in the Pottery Industry

By G. W. Jarman, Jr: Separations Engineering Corp., 110 E. 42d St., New York, N. Y.

The possible use of metallizing in the ceramic industry is discussed under the following headings: (1) Decoration: plates, lamps, vases, all with or without stencil, in tin, zinc, copper, lead, aluminum, brass, or bronze. (2) Strengthening factor against chipping, cracking, etc., and strengthening of cooking vessels which can have a metallic coating of any desired thickness on their outside, such as copper, which could be buffed and would require no glazing; the way will be pointed out for the possibility of treating setters and saggers with a coating to withstand firing temperature. (3) Work on insulators both from the electrical and utilitarian standpoint, *e.g.*, if they wish to attach an insulator to a copper wire, it is possible to do so by spraying on a copper bushing and then sweating the copper into this bushing. Samples will be presented for inspection.

3:40–4:00 P.M.

12. Computation of Heat Treatments for Whiteware Bodies (published *Jour. Amer. Ceram. Soc.*, **21** [3] 75–79 (1938))

By W. W. Meyer: National Bureau of Standards, Washington, D. C.

The constant in Arrhenius' equation when applied to the vitrification process of feldspathic whiteware bodies was calculated, using known data. Proceeding from this point, a mathematical expression for the amount of reaction taking place in a normal whiteware mixture, when heated according to a given schedule, was obtained. Formulas were also derived for calculating heating schedules of various rates of temperature rise and lengths of soaking period productive of a given amount of reaction. The calculated amounts of reaction necessary to vitrify feldspathic whiteware bodies were correlated with the RO contents of the bodies. Data on the physical properties of variously heat-treated bodies are given to substantiate the validity of the formulas. A chart is given by means of which many heat-treatment problems can be solved without using the mathematical formulas.

4:00–4:30 P.M.

Business Session

For General Sessions on Symposium on Glazes, Thursday Forenoon and Afternoon, see pages 94 and 95.

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February 19, 1938

Members of A. C. S. and friends.

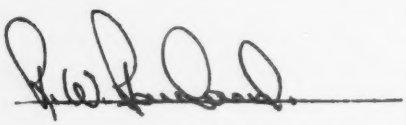
Gentlemen:

The annual Meeting of the American Ceramic Society again affords us the opportunity to thank our hosts of friends for the confidence placed in us during the past year.

It always has been and will continue to be the policy of the New Castle Refractories Company to maintain a staff of trained personnel sufficient to keep abreast of the continual improvement in refractories. Since the foundation of business is mutual benefit, resulting from confidence, integrity, service, honesty and fair dealing, our policy will be continued along these lines.

During the past year we have been privileged to serve a number of concerns for the first time. To the hosts of customers who we have regularly been serving for a number of years, and to this group of new-found friends, we extend the service of the personnel of this company in whatever capacity may be required.

Sincerely yours,
NEW CASTLE REFRACTORIES CO.



Roger W. Rowland-President

RWR:HLS

"New Castle"
HOT TOPS

FORTIETH ANNUAL MEETING OF THE AMERICAN CERAMIC SOCIETY

March 27–April 2, 1938

HIGHLIGHTS OF NEW ORLEANS HISTORY FOR THE AMERICAN CERAMIC SOCIETY

Presented by Tulane, Newcomb, Louisiana State University, Loyola, and Dominican College Students

I. Settling of New Orleans, 1717: Iberville and Bienville, the famous brothers responsible for New Orleans' beginning, are entertained at a Creole Ball.

II. The Casket Girls. Shortly after. Nouvelle Orleans was settled, "Naughty Marietta" and other Casket Girls arrive, destined for wives of early settlers; the little French girl, Marietta, sings for Orleanians.

III. Louisiana Purchase Era: "Affaires du Coeur" are settled under the famous duelling oaks in City Park.

IV. Battle of New Orleans: Jean Lafitte, the Pirate, holds the spotlight; slave girls dance for the pirates; General Andrew ("Old Hickory") Jackson enlists Lafitte's help to vanquish the British at Chalmette, and the two world-famous leaders thresh out the situation over cups of Cafe Brulot.

V. Sons of New Orleans Fight for the South: During the War between the States, the Crescent City sends many brave men to the battlefields; the wearers of the Grey are true scions of Dixie.

VI. The Floradora Era: New Orleans in the Nineties sees many new-fangled inventions become vogue, such as the automobile and the bathtub.

VII. New Orleans, the Birthplace of Jazz: The Original Dixieland Jazz Band, a group of five Orleanians, gives to these United States a new type of music, "Jazz"; they also introduce a new dance, the "Mississippi Shuffle."

VIII. A Vieux Carre Street Scene: Banquettes are lined with colored mammies selling pralines, negro chimney sweeps chant their unique cry, piccaninnies dance to the raucous beat of soap-box drums, gallants converse in French, light ladies promenade sinuously, and Creole belles sing from balconies.

IX. Ceramics Makes History: Meeting in New Orleans for first time; a group of Louisiana Collegians in modern attire present the "Big Apple," dedicated to this gathering.

X. There will be general dancing and dining for guests and patrons of the evening. "The Tulanians," New Orleans No. 1 orchestra, composed of eleven students at the University, will furnish dance music.

Thirty-seven collegians from Louisiana's leading universities and colleges will appear in the gala Sunday night inaugural floor show in the Grand Ball Room of the Roosevelt Hotel, which will be presented for early arrivals to the American Ceramic Society Annual Meeting.

Most of these students from time to time have appeared on the College Night floor shows in the Blue Room, the Roosevelt's supper-dance club. Tulane University heads the talent list with 20 representatives, Newcomb College for Women with 6, Louisiana State University with 5, Loyola University with 4, and Dominican College for Women with 2, all students of exceptional histrionic talent.

The Louisiana State University talent group will motor to New Orleans from the State capital, Baton Rouge, to participate in the program. The students from the other four universities hail from New Orleans where the schools are located.

The collegians, directed by John Arthur, College Night's impresario, will present "The Highlights of New Orleans History," a panorama of the Crescent City's outstanding events from the settling of New Orleans in 1717 by the famous brothers, Iberville and Bienville, up to the present day.

TULANE UNIVERSITY'S DEPARTMENT OF MIDDLE AMERICAN RESEARCH

When members of the American Ceramic Society visit Tulane University's Department of Middle American Research, during the New Orleans Meeting, they will see one of the most unusual institutions under the academic mantle anywhere in the world.

They will behold, for example, the only thing of its kind: the only institution created for the expressed purpose of conducting advanced research in "Middle America," an arbitrary but satisfactory name for that vast area which includes Mexico, Central America, the West Indies, and the Bahamas, a region fabulously rich in physical resources, in historic background, in commercial potentialities, and in possibilities for almost any kind of scientific investigation.

They will see the world's foremost library on that field. And in that library they will see curious documents and manuscripts of tremendous importance, historically no less than scientifically. To name one, there is the most important legal manuscript in the whole western hemisphere: the original manuscript of the first laws drawn up

on the American mainland, dictated and signed by none other than the great conqueror, Hernando Cortés, in 1524. Only a few years after he defeated the Aztec hordes in Mexico, Cortés saw the necessity for clarifying and preserving some of the vital rules he had laid down orally and of adding to them. He did this, and two copies were made. One was sent to the Emperor in Spain; the other, Cortés kept. Tulane's Department of Middle American Research has that copy.

Giant Maya four-legged clay vessel in polychrome design, from Siguatepeque, Spanish Honduras (diameter, 48 cm., height, 28.5 cm.).

They will see, also, a museum that contains a more complete collection of ancient Maya ceramics, artifacts, and remains than is to be found anywhere else. But the museum is not limited to the Maya. There are also representative collections from the territories of the Aztec, the Totonac, the Huastec; there are objects from Cuba, from Haiti and Santo Domingo, from Honduras and Panama and Costa Rica and El Salvador; from north Mexico and South Mexico. There is modern ethnology

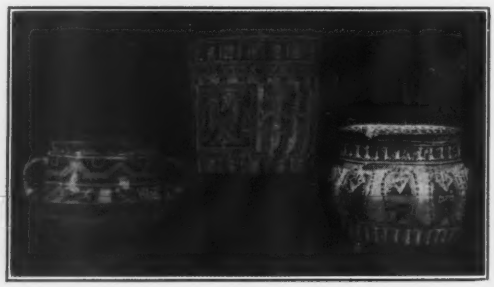
Maya musical instruments from Ulua Valley, Spanish Honduras; (1) clay ocarina, plays six notes, scored in (2); (3) another form of ocarina, plays six notes (height of (3) is 12.6 cm.).

and beside it is archeology in profuse quantities. The Department of Middle American Research has the world's most complete collection of the quaint and colorful costumes of present-day Guatemala Indians, which stem from the raiment of the Maya of a thousand years ago, but which are disappearing rapidly as "store-boughten" clothes and modern synthetic dyes cut a wide path through the age-old textile industry of those Indians.

Ceramics are everywhere in the museum of the Department of Middle American Research. Not only are there innumerable examples of the potter's art from the America of a long-vanished yesterday, but pieces demonstrating present-day methods of manufacture from the Middle American countries. Officials of the department

Original Maya clay mold for mass production of figurines, from Ulua Valley, Spanish Honduras, about A.D. 1000: (1) cast from mold; (2) the original mold; (3) and (4) casts in plaster (height of (4), 18.5 cm.)

have not stopped at collecting within the boundaries of their prescribed territory; they have gathered what is known as "marginal material," specimens of the arts and crafts of peoples who border upon Middle America, or who might be related, ethnologically, to the Middle Americans. There is a magnificent Peruvian collection of ancient ceramics; for instance, the work of Nasca and Chimu potters centuries before there was an Inca people in Peru.



Maya polychrome clay vases from Ulua Valley, Spanish Honduras, about A.D. 800 (height of center vase, 17.5 cm.).

The museum and library are crowded, but plans are afoot for a building and adequate endowment to expand the Department's work, and so phenomenally has the Department of Middle American Research grown in its fourteen years of existence that its public is pretty serene about expecting it to have a building and endowment in relatively short order.

Meanwhile, it is doing its best to show its collections. There are more ceramics than anything else.

NEWCOMB ART SCHOOL

Newcomb College was founded in 1886 as an integral part of the Tulane University of Louisiana by an endowment of Mrs. Josephine Louise Newcomb as a memorial to her deceased daughter, H. Sophie Newcomb. The administrators of the Tulane Educational Fund were entrusted with the donation to establish a college for the higher education of young girls and white women. In thus perpetuating the memory of an only child, Mrs. Newcomb enabled the Tulane administrators to round out the ideal of a university by the creation of an institution that would give in a separate college for women all of the educational advantages which had before been offered only to men.

The college was organized in October, 1887. The building at first occupied was a large private dwelling now replaced by a commercial building on the corner of Howard Avenue and Camp Street; but in 1891 the college was removed to Washington Avenue and Camp and Chestnut streets. The growth of the institution, however, made it necessary to move a second time in June, 1918, to buildings suitable to the present demands and, as far as possible, adapted to future requirements.

During the early years of the college, an art department was established with Ellsworth Woodward as director. This department has been known as the Newcomb School of Art, with a separate building on the main campus. The Art Building, in which is offered every facility for the study and practice of fine arts, contains three galleries, an art library, and special rooms for the various crafts, such as pottery, metalwork, jewelry, weaving, bookbinding, etc.

Both students and faculty of the college extend a cordial welcome to members of the American Ceramic Society attending the New Orleans Meeting to visit the Art Building. The department is open from 9:00 A.M. to 5:00 P.M. each day except Sunday.

Sixth National Ceramic Exhibition Shown

The Sixth National Ceramic Exhibition will be in the Art School galleries the entire week of the ceramic Meeting. This is a group of some 250 pieces of pottery and ceramic sculpture circuited by the Syracuse Museum of Art, which has been selected from the entire showing in that gallery at the time of the Art Division Meeting in Syracuse, N. Y., in October, 1937. Many interested members of the Society do not regularly have the privilege of seeing this Annual Exhibition of contemporary American ceramics. Since this exhibit is a memorial to Mrs. Adelaide Robineau, there will also be shown a small collection of porcelains made by Mrs. Robineau.

Newcomb Pottery

Newcomb College is the home of Newcomb pottery, which is designed and decorated by graduates of the Art School. The studios will be open for inspection, and a representative collection of the ware will be set up, showing the changes in types since its beginning in 1897. The first, and, perhaps, the most noteworthy appeal of this ware is in its artistic quality. This is reasonable, inasmuch as the ware had its origin in a school of art, and its very circumstance of development has been guided by the desire to conform to the highest ideals of design and workmanship. It is, moreover, wholly indigenous. The clay is found in St. Tammany Parish of Louisiana. The designers are southern women educated in the Newcomb School of Art. The land of the orange and the palm, the magnolia and jasmine, the bearded cypress, the noble oak, and the stately yellow pine has furnished the rich material for decoration, hitherto but little used in American art, inasmuch as art study had been quite generally confined to northern latitudes.

Lecture by R. Guy Cowan

There will be a general exhibit in one of the art galleries of the work of Newcomb students. This will include drawings, paintings, metalwork, book-binding, and pottery done entirely by the students as classwork during the present college year. We also have the pleasure to announce that Newcomb College will sponsor a lecture to be given by R. Guy Cowan on "Ceramic Art," in Dixon Hall at 8:00 P.M. on Thursday, March 31. All members of the Society are cordially invited to attend.

LOUISIANA DEPARTMENT OF CONSERVATION DISPLAY BOOTH OF RAW MATERIALS

This booth occupies an area of 22 by 15 feet, and was built by Clark's Studio, Shreveport, La. The general design is modernistic with curves and flat surfaces forming shelves at either end of the booth. It is colored in three shades of blue and white, the base being dark blue, blending into lighter tones toward the top.

Approaching the exhibit from the left or lower side is a large illuminated map of Louisiana six feet square. This map presents pictorially and in natural color the location of the raw products of the State in relation to the facilities for transportation such as highways, rivers, and railroads. At the base and to the left of this map on low projecting shelves is the display of the Myles Salt Company. It consists of two mounted photographs of drilling in the mine and samples ranging from the rock salt to the finer table salt.

The central back portion of the exhibit is a large natural-colored painting of a Louisiana live oak covered with moss and a sloping landscape showing oil derricks. Across the irregular shape of clouds above the tree and the oil derricks are large solid letters forming the word "Louisiana."

Between the map and the oak tree, about half way up to the top of the exhibit, is a "horn of plenty" out of which rolls miniature electric trucks loaded with such products as cotton, sulfur, furs, and various other raw materials of the State. These little trucks run constantly from the mouth of the horn down a small hill to the other side of the exhibit. Just below the horn of plenty and toward the base of the map runs a chain of small river boats loaded with some of the commodities which are exported from the State. (This animated feature of the exhibit caused a great deal of attention at the 16th Annual Exposition of

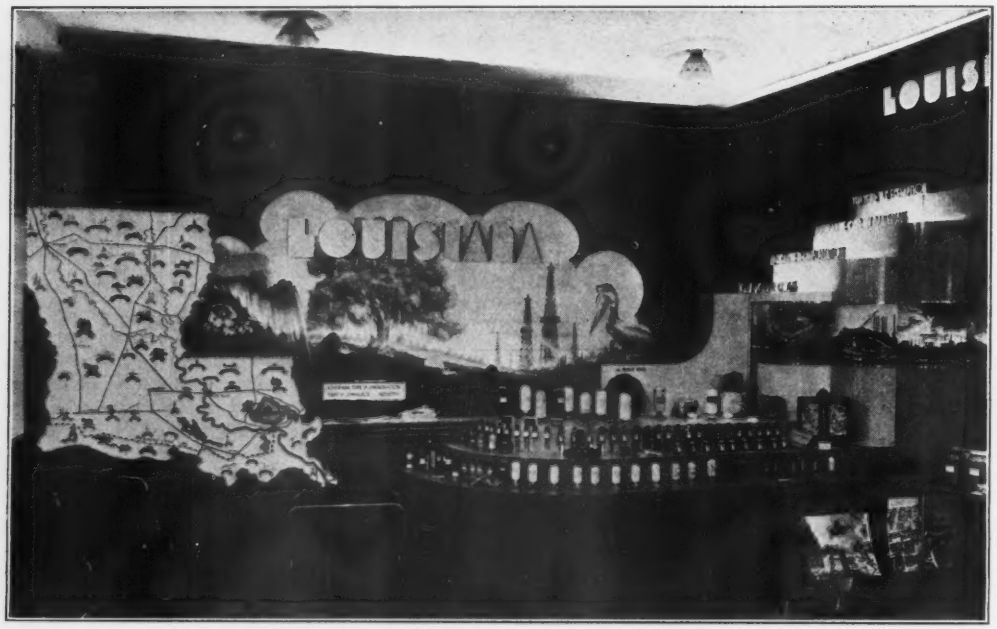
Chemical Industries, held in New York City, and was one of the most attractive units displayed.)

From the center of the exhibit to the right are three tiers of long low shelves. Just above the shelves on a short, projecting arm is the Louisiana State Bird, "The Pelican," painted in silver to harmonize with the color scheme. On the shelves are displayed from top to bottom, (1) Godchaux sugars and some samples of native sulfur, (2) petroleum products of the Texas Company and the Gulf Oil Corporation, Tung oil, Tung nuts, and some samples of ramie, and (3) Mackie pine oil products, salt samples, and Gaylord pine pulp products. At the base of the shelves are large photographs loaned by Godchaux, of sugar-cane harvesting. At the extreme right on a small table are samples of Celotex and Spanish moss.

The right end of the booth is the tallest and widest section of the display. There are four curved walls. Each one of these walls rests flat against the next one and, from the nearest out to the extreme right, each is a little taller than the wall preceding. On the top of these projections, and well illuminated, are four signs reading: (1) low power costs, (2) adequate transportation, (3) abundance of raw materials, and (4) (the tallest and most prominent) ten-year tax exemption. These four signs are prominently placed and can easily be read before one reaches the booth. They are the four points stressed in the State's Industrial Program under Governor Leche.

Across the middle of these four flat surfaces, mounted in chromium strippings, are large photographs of local plants already located in Louisiana, which include the refinery of the Standard Oil Company of Louisiana, the Ethyl Gasoline Plant, the Solvay Alkali Plant, and others.

Black velvet curtains fill in the back of the booth from ceiling to floor, and on the right end, above the booth, on the curtains, is a smaller sign, "Louisiana."



Louisiana Department of Conservation Display Booth

SUGGESTED TOURS OF THE VIEUX CARRÉ IN NEW ORLEANS

Mrs. Martha Gasquet Westfeldt, Chairman of the Local Art Division, has made plans for the following tours for the benefit of our members attending the Fortieth Annual Meeting.

Sunday Afternoon, March 27

Cemeteries Tour*

Tour by bus with guide, comprising St. Louis Cemetery (one of the oldest in the country), the Esplanade, the Bayou St. John, where the old Spanish Customhouse is located, City Park, Country Club, and the Metairie Cemetery with modern mausoleums of great interest.

* Price for bus accommodating 30 people: to be ascertained. Price for guide: $5.00. Time: about 2 hours.

Monday Morning, March 28

Garden District, Audubon Park*

Tour through uptown section and Garden District (Robinson House, Garden District, and visit to gardens). (Mrs. Westfeldt has invited members to visit her own garden.)

Audubon Park, opposite Tulane University, ending at Tulane for lunch.

Tuesday Morning, March 29

Walking Tour

(1) Vieux Carré general tour (on foot) starting at the Roosevelt Hotel. This tour comprises nine to ten blocks of the most interesting part of the city. It starts down

Bourbon Street to Bienville and visits the Wig Maker's House, Madam Rapho, E. H. Sothern's birthplace, the historic old Absinthe House, built about 1750, which was frequented by Jean Lafitte, famous Barataria pirate, and where Andrew Jackson is believed to have planned the Battle of New Orleans; the Conservation Building, where mounted specimens of all the animal life of Louisiana are to be exhibited; the old Bank of Louisiana, erected in 1812, and the former seat of the financial district; Waldhorn's Antique Shop, one of the most comprehensive antique shops in the country; Étienne de Bore, pioneer manufacturer of granulated sugar; Patio Royal, established in 1804 through the influence of Thomas Jefferson, and later the home of Paul Morphy, world-famous chess champion; a tour through Governor Miro's House, 1784, showing the manner of living at the time; Napoleon's House; the Grima House, 1831, a charming type of colonial architecture and a beautiful courtyard; Seignoret's House, a cabinet manufacturer of furniture unique to New Orleans, afterward occupied by Brulatour, wine merchant; the Gate of the Two Lions; the home of Robert Edson, the father of the American stage; the courtyard of the golden-voiced singer, Adelina Patti; the Green Shutter courtyard, first five- and ten-cent store where they sold quarti and picayune of merchandise; the first skyscraper, Pirate's Alley, St. Anthony's Garden; the Orleans Theatre, erected in 1819, where the State Legislature met in 1826, and the scene of the famous quadroon balls; the famous French Market erected by the Spaniards in 1791; the Cabildo, Louisiana State Museum, one of the notable museums of the United States built in 1795 (it was here that the formal transfer of Louisiana to the United States consummated the Louisiana Purchase in 1803); the Pontalba Buildings built in 1849 by the Baroness Pontalba (Jenny Lind and William Makepeace Thackeray were entertained by the Baroness in one of these buildings); Jackson Square of the Place d'Armes; the Presbytery; Cloister Alley; St. Louis Cathedral, one of the most famous churches in North America; the old Spanish arsenal; the Little Theatre; Le Petit Salon; and the Arts and Crafts Club with its unusual collection of modern art. The tour ends with luncheon at the Courtyard Kitchen or Louisiane Restaurant.

Tour for 20 people or less, preferably 10 to each guide: $5.00

Tuesday Afternoon, March 29

Cabildo Tour

This tour will be conducted in a more leisurely fashion and will comprise only certain points of interest and end at the Cabildo, where there will be special guides arranged to show the groups around and more time will be spent in viewing the Museum. Leaving the hotel, the tour starts from the Absinthe House, goes through Waldhorn's, the St. Louis Cathedral, the French Market, the Little Theatre, and ends at the Cabildo at 3:30 P.M. The remaining portion of the afternoon will be spent there.

Tour for 20 people or less, preferably 10 to each guide: $5.00

Wednesday Morning, March 30

French Market Tour

This tour will start at the hotel and go direct to the Ursuline Convent, visiting General Beauregard's House; the French Market, where coffee can be served; the Place d'Armes, and the Cathedral. It is a short tour of about two hours.

Tour for 20 people or less, preferably 10 to each guide: $5.00

An alternate morning trip is planned for those who do not care to visit the Vieux Carré or who have already done so on Tuesday. There will be a choice of a trip to the Huey Long Bridge, a sight-seeing bus through the City of New Orleans, the Kingsley House Settlement Potteries, and the Shushan Airport.

Arts and Crafts Club Tour

This tour visits Waldhorn's Antique Shop, Casey and Casey, the English Antique Shop, Governor Miro's House, and the Arts and Crafts Club.

Tour for 20 people or less, preferably 10 to each guide: $5.00

Plantation Tours

Private plantation tours can be arranged, accomodating six to one car.

Per person, including lunch: $5.00
Time: about 8 hours

HOTEL RATES IN NEW ORLEANS

De Soto

Singles with bath	$3.00, 4.00, 5.00
Doubles " "	5.00, 6.00
Twin beds " "	6.00, 7.00, 8.00

Jung

Singles with bath	$3.00, 3.50, 4.00, 5.00
Doubles " "	5.00, 6.00, 7.00
Twin beds " "	6.00, 7.00, 8.00

La Salle

Doubles with bath	$4.00, 5.00
Twin beds " "	5.00, 6.00

Monteleone

Singles with bath	$3.00, 4.00
Doubles " "	5.00, 6.00, 7.00
Twin beds " "	6.00, 7.00, 8.00

New Orleans*

Singles with bath	$3.00, 4.00, 5.00
Doubles " "	5.00, 6.00
Twin beds " "	6.00, 7.00

Pontchartrain

Apartments to accommodate 2 persons	$8.00 per day
" " " 4 "	15.00 " "

Roosevelt

Singles with bath	$3.50, 4.00, 5.00, 6.00
Doubles " "	5.50, 6.00, 7.00, 8.00
Twin beds " "	7.00, 8.00, 9.00

St. Charles

Singles with bath	$3.00, 3.50, 4.00, 4.50, 5.00
Doubles " "	5.00, 5.50, 6.00, 6.50, 7.00
Twin beds " "	6.00, 7.00, 8.00

* Commercial hotel: Not more than 40 or 50 rooms available for Meeting guests.

GREYHOUND BUS FARES TO NEW ORLEANS

	One Way	Round Trip
Houston, Tex.	$ 6.50	$11.70
Dallas, Tex.	7.75	13.95
Ft. Worth, Tex.	8.30	14.95
San Antonio, Tex.	9.50	17.10
El Paso, Tex.	19.45	35.05
Los Angeles, Calif.	27.50	49.50
San Francisco, Calif.	27.50	49.50
Seattle, Wash.	36.00	64.80
Denver, Colo.	20.25	36.45
Kansas City, Mo.	13.20	23.85
St. Louis, Mo.	9.50	17.10
Chicago, Ill.	12.30	22.15
Memphis, Tenn.	6.50	11.70
Cincinnati, Ohio	10.75	19.35
Detroit, Mich.	14.20	25.60
Chattanooga, Tenn.	6.75	12.15
Pittsburgh, Pa.	14.50	26.10
Atlanta, Ga.	6.65	12.00
Washington, D. C.	13.85	24.95
New York, N. Y.	16.55	29.80
Savannah, Ga.	8.80	15.85
Jacksonville, Fla.	8.20	14.80
Tampa, Fla.	10.65	19.20
Miami, Fla.	12.95	23.35

STUDENT HOTEL RATES IN NEW ORLEANS

Rates for the students who will attend the Fortieth Annual Meeting of the Society are quoted by the hotels as follows:

MONTELEONE: $1.50 per person, room with bath, $1.00 without bath.

ST. CHARLES: $1.50 per person, room with bath.

DE SOTO: $1.00 per person, room without bath.

JUNG: $1.50 per person, room with bath.

LA SALLE: $1.00 per person, room without bath; $8.00 two connecting rooms with bath between, accommodating 7 persons.

ROOSEVELT: Five in a room (with bath) $2.00 per person; four in a room (with bath) $2.50 per person.

Above rates (with the exception of the Roosevelt and La Salle) are based on six to eight persons to a room.

—SAM FOWLKES, *Secretary, Convention and Visitors' Bureau*

RAILROAD FARES

The following are rail and Pullman rates from points shown to New Orleans:

From	Round-Trip R. R. Fares	One-Way Pullman Fares			
		Lower	Upper	Compartment	Drawing Room
b Anderson, Ind.	$42.25	$6.75	$5.40	$19.00	$24.00
b Athens, Ohio.	48.15	7.25	5.80	20.50	26.00
b Alliance, Ohio.	53.95	8.00	6.40	22.50	28.00
b Akron, Ohio.	53.55	8.00	6.40	22.50	28.00
a Boston, Mass.	78.65	*9.75	*7.80	*27.50	*35.00
b Buffalo, N. Y.	64.35	9.00	7.20	25.50	32.00
a Baltimore, Md.	53.75	8.00	6.40	22.50	28.00
a Chester, Pa.	58.75	9.00	7.20	25.50	32.00
b Cleveland, Ohio.	53.95	8.00	6.40	22.50	28.00
b Corning, N. Y.	68.90	9.75	7.80	27.50	35.00
b Chillicothe, Ohio.	44.55	7.00	5.60	20.00	25.00
b Columbus, Ohio.	45.65	6.75	5.40	19.00	24.00
b Cincinnati, Ohio.	38.75	6.00	4.80	17.00	21.00
d Chicago, Ill.	42.25	6.75	5.40	19.00	24.00
b Detroit, Mich.	53.95	8.00	6.40	22.50	28.00
b Elmira, N. Y.	68.90	9.75	7.80	27.50	35.00
b East Liverpool, Ohio	55.05	8.00	6.40	22.50	28.00
c Evansville, Ind.	31.75	5.00	4.00	14.00	18.00
a Elizabeth, N. J.	64.05	9.75	7.80	27.50	35.00
b Gas City, Ind.	42.25	6.75	5.40	19.00	24.00
a Hartford, Conn.	71.45	*9.75	*7.80	*27.50	*35.00
b Hornell, N. Y.	68.90	9.00	7.20	25.50	32.00
b Indianapolis, Ind.	41.95	6.00	4.80	17.00	21.00
b Keyser, W. Va.	51.45	8.00	6.40	22.50	28.00
b Kokomo, Ind.	42.25	6.75	5.40	19.00	24.00
d Louisville, Ky.	35.60	5.50	4.40	15.50	20.00
b Martinsburg, W. Va.	51.45	8.00	6.40	22.50	28.00
b Muncie, Ind.	42.25	6.75	5.40	19.00	24.00
a New York, N. Y.	64.85	9.75	7.80	27.50	35.00
a Newark, N. J.	64.35	9.75	7.80	27.50	35.00
b Olean, N. Y.	68.50	9.00	7.20	25.50	32.00
a Plainfield, N. J.	62.65	9.75	7.80	27.50	35.00
a Philadelphia, Pa.	59.45	9.00	7.20	25.50	32.00
b Pittsburgh, Pa.	53.75	8.00	6.40	22.50	28.00
b Rochester, N. Y.	64.35	9.75	7.80	27.50	35.00
a Springfield, Mass.	72.95	*9.75	*7.80	*27.50	*35.00
b Sandusky, Ohio.	51.25	8.50	6.80	24.00	30.00
b Sebring, Ohio.	53.95	8.00	6.40	22.50	28.00
b Schenectady, N. Y.	64.85	9.75	7.80	27.50	35.00
b Syracuse, N. Y.	64.85	9.75	7.80	27.50	35.00
d St. Louis, Mo.	31.75	5.25	4.20	15.00	19.00
b Toledo, Ohio.	50.55	7.50	6.00	21.00	27.00
b Tiffin, Ohio.	49.85	8.25	6.60	23.50	29.00
c Terra Haute, Ind.	36.70	5.50	4.40	15.50	20.00
a Trenton, N. J.	61.45	9.00	7.20	25.50	32.00
a Worcester, Mass.	76.25	*9.75	*7.80	*27.50	*35.00
a Wayne Junction, Pa.	59.85	9.00	7.20	25.50	32.00
a Wilmington, Del.	57.95	8.75	7.00	24.50	31.00
a Washington, D. C.	51.45	8.00	6.40	22.50	28.00
b Wheeling, W. Va.	51.45	8.00	6.40	22.50	28.00
a West Trenton, N. J.	61.45	9.00	7.20	25.50	32.00

Notes

The above rates are eighteen-day winter tourist fares applying to New Orleans.

* Rates apply from New York only.

(*a*) Rates quoted—tickets may be routed via Cincinnati in both directions or via Atlanta, Ga., and Washington, D. C., on the return.

(*b*) Rates quoted—tickets routed via Cincinnati in each direction.

(*c*) Rates quoted—via Evansville, Ind., in each direction.

(*d*) Rates quoted—direct routes.

Stop-overs are permitted within the time limit of your ticket.

If sufficient number of members, friends, and guests, residing in the territory between Boston and Washington, D. C., attend the New Orleans Meeting, a special train will be operated from New York to New Orleans via Cincinnati, Ohio, over the Baltimore & Ohio and Louisville & Nashville Railroads.

Eastern members are requested to arrange reservations promptly for the purpose of making it possible to operate special train.

Information regarding an American Ceramic Society breakfast at the Cincinnati Terminal, Saturday morning, March 26, will be mailed later.

—TRANSPORTATION COMMITTEE

V. V. KELSEY NOMINATED FOR PRESIDENT

Victor V. Kelsey was awarded a Bachelor of Science degree by the Virginia Polytechnic Institute, Blacksburg, Va., majoring in chemistry and mineralogy.

After leaving school, he worked in the chemical laboratory of the Carnegie Steel Company, Duquesne, Pa.; for about two years he was head chemist for the Virginia Iron Coal & Coke Company at Roanoke, Va.; and for seven years he was chief chemist, and later industrial agent, of the Clinchfield Railroad at Erwin, Tenn., and Johnson City, Tenn. This work included the investigation of the mineral and other natural resources tributary to the Clinchfield Railroad for the development of these resources. During this period the following industries were established along the Clinchfield to avail themselves of the resources: face brick, building brick, Portland cement, burned and hydrated lime, tannic acid, kaolin mining and refining, the first feldspar development in North Carolina, the first feldspar mill in Tennessee, the development of mica-refining plants, limestone quarries, textiles, leather, semiporcelain dishes, electrical porcelain, glass, charcoal, acetate of lime, acetone, organic chemicals, cellulose acetate, glass sand, and other industries.

During the war, he was in charge of constructing a large chemical plant at Kingsport, Tenn., for the Bureau of Air Craft Production. After the war, he was assistant works manager of the Corning Glass Works, Corning, N. Y., and later was in charge of the Knox Porcelain Company, Knoxville, Tenn. Since 1925 he has been actively engaged in the feldspar industry as sales manager for the Consolidated Feldspar Corporation, Trenton, N. J.

Mr. Kelsey joined the American Ceramic Society in 1923. For three years, he served as a representative on the Board of Trustees for the Materials and Equipment Division. During 1937–1938 he has been Vice-President of the Society.

For the past several years Mr. Kelsey has been a member of the research committee of the National Feldspar Association and a member of the Executive Committee of the Ceramic Association of New Jersey; he has also served as Vice-President, President, and Chairman of the Executive Committee of the latter Association.

He has written several papers pertaining to feldspar, its production, refining and use in the ceramic industry, and a number of papers dealing with the natural resources tributary to the Clinchfield Railroad.

E. H. FRITZ NOMINATED FOR WHITE WARES DIVISION TRUSTEE

Edwin Henry Fritz, White Wares Division nominee for Trustee, was born March 9, 1895, at Toledo, Ohio. He attended public schools at Dubuque, Iowa, and Toledo, Ohio, and received the degree of Bachelor of Ceramic Engineering from Ohio State University in 1917.

In 1917 he worked in the engineering department of the American Blower Co., Detroit, Mich. In the same year he entered the employ of the Westinghouse Electric and Mfg. Co., Derry, Pa. He has held the following positions at the Westinghouse plant: assistant ceramic engineer, 1917–1919; ceramic engineer, 1919–1927; assistant works manager, 1927–1930; engineering manager, 1930–1934; and manager, Porcelain Division, from 1934 to the present time.

Among the technical societies of which Mr. Fritz is a member, his active work has been confined entirely with the American Ceramic Society. He has served as Secretary and Chairman of the White Wares Division, and on the Rules Committee and the Education Committee in 1937. With Mr. White and Mr. Marbaker he compiled a valuable report containing data on ceramic education. This was published in the *Bulletin* for March 1937, pages 116–20.

E. H. Fritz

He was elected to the Committee on Education as the engineering member, and will serve five years on that Committee. He is also a member of the Advisory Committee of the White Wares Division and of the Organizing Committee of the Institute of Ceramic Engineers.

Publications

"Study of Draft Movements in Flues," *Jour. Amer. Ceram. Soc.*, **1**, 294 (1918).

"Modern Production of Suspension Insulators," *Jour. Amer. Inst. Elec. Engrs.* (1921).

"American Clays as Compared to English Clays in Whiteware Bodies," *Jour. Amer. Ceram. Soc.*, **8** [4] 253–56 (1925).

"Some Successful Cone 10 Sagger Bodies," *ibid.*, **9** [9] 606–12 (1926).

"Tunnel Kiln Installation for Porcelain Insulators," *ibid.*, **12** [11] 711–15 (1929).

"Quality Control System in a Porcelain Insulator Plant," *Bull. Amer. Ceram. Soc.*, **10** [10] 313–18 (1931).

"Stress Problems Overcome in Cemented Insulators," *Elec. World*, **100** [7] 221–22 (1932).

"Soldered Porcelain and Glass in the Electrical Industry," *Ceram. Ind.*, **19** [6] 279–83 (1932).

"Present Practice and Developments in Firing Electrical Porcelain," *Jour. Amer. Ceram. Soc.*, **20** [1] 26–30 (1937).

"Raw Material Requirements in Whiteware and Glass Industries," *Bull. Amer. Ceram. Soc.*, **16** [6] 231–33 (1937).

Publications with Co-Authors

with A. L. Donnenwirth, "Some Observations in Casting of Heavy Electrical Porcelains," *Jour. Amer. Ceram. Soc.*, **8** [9] 547–51 (1925).

with H. M. Kraner, "A Study of Some Factory Processes," *ibid.*, **10** [5] 357–66 (1927).

MEMBERS OF STANDING COMMITTEES, 1937–1938

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HEWITT WILSON: University of Washington, Seattle, Wash.

Committee on Data

F. P. HALL, *Chairman:* Onondaga Pottery Co., Syracuse, N. Y.
J. C. HOSTETTER: Hartford-Empire Co., Hartford, Conn.
WALTER A. WELDON: 621 Edgwood St., Baltimore, Md.

Special Committee on Data for Geologists' Handbook

L. NAVIAS: General Electric Co., Schenectady, N. Y.

Committee on Ceramic Education

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H. E. WHITE: Lava Crucible Co., Zelienople, Pa. (Industry Member, 2 years)
N. W. TAYLOR: Pennsylvania State College, State College, Pa. (Technology Member, 3 years)

F. H. RHEAD: Homer Laughlin China Co., Newell, W. Va. (Art Member, 4 years)
E. H. FRITZ: Westinghouse Electric & Mfg. Co., Derry, Pa. (Engineering Member, 5 years)

Subcommittee on Engineering Education
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Committee on Nomination and Election of Fellows: F. H. RIDDLE, EMILY C. VAN SCHOICK, AND HOBART M. KRANER
Committee on Honorary Membership: ALEXANDER SILVERMAN, R. GUY COWAN, AND M. E. HOLMES

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American Association for the Advancement of Science
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American Foundrymen's Association
L. C. HEWITT, *Chairman:* Laclede-Christy Clay Products Co., St. Louis, Mo.
J. L. LOWE, Box 4, Muskegon Heights, Mich.
G. A. BOLE, O. S. U. Engineering Experiment Station, Columbus, Ohio
PAUL BECHTNER, American Colloid Co., 363 W. Superior St., Chicago, Ill.

American Society for Testing Materials
Committee A-1 on Steel: H. F. STALEY, Metal & Thermit Corp., New York, N. Y.
Committee C-8 on Refractories: N. W. TAYLOR, Pennsylvania State College, State College, Pa.
Committee C-11 on Gypsum: R. F. GELLER, Bureau of Standards, Washington, D. C.
Committee C-14 on Glass and Glass Products: J. C. HOSTETTER, Hartford-Empire Co., Hartford, Conn.
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A. F. GREAVES-WALKER, University of North Carolina, Raleigh, N. C.
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American Society of Mechanical Engineers
Petroleum Division: H. R. STRAIGHT, Straight Engineering Co., Adel, Iowa
Process Division: W. KEITH MCAFEE, Universal Sanitary Mfg. Co., New Castle, Pa.

American Standards Association
Sectional Committee on Minimum Requirements for Plumbing and Standardization of Plumbing Equipment (Project A-40): P. D. HELSER, General Ceramics Co., New York, N. Y.
Sectional Committee on Recommended Practice for Brick Masonry (Project A-41): FREDERICK HEATH, JR., Colonial Clays, Inc., Worcester, Mass.
Sectional Committee on Insulators for Electric Power Lines (Project C-29): D. H. ROWLAND, Locke Insulator Corp., Baltimore, Md.
Sectional Committee on Classification of Coals (Project M-20): W. H. FULWEILER, 1600 Arch St., Philadelphia, Pa.
Sectional Committee on Scientific and Engineering Symbols and Abbreviations (Project Z-10): L. E. BARRINGER, General Electric Co., Schenectady, N. Y.
Sectional Committee on Specifications for Sieves for Testing Purposes (Project Z-23): A. S. WATTS, Ohio State University, Columbus, Ohio
Sectional Committee on Specifications and Methods of Test for Safety Glass (Project Z-26): A. E. MARSHALL, 501 Fifth Avenue, New York, N. Y.; DONALD E. SHARP (*alternate*)

International Association for Testing Materials
A. S. WATTS, Ohio State University, Columbus, Ohio

International Congress on Glass and Ceramics
J. C. HOSTETTER, Hartford-Empire Co., Hartford, Conn.

International Union of Chemistry
ALEXANDER SILVERMAN, Univ. of Pittsburgh, Pittsburgh, Pa.

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Orton Foundation Board

J. M. MCKINLEY, North American Refractories Co., Cleveland, Ohio

United States Department of Commerce, Division of Simplified Practice: Permanent Committee on Simplification of Variety and Standards of Vitrified Paving Brick

C. C. BLAIR, Metropolitan Paving Brick Co., Canton, Ohio

Committee on Patents (temporary)

F. B. FLICK, *Chairman:* 1706 First National Bank Bldg., Pittsburgh, Pa.
J. C. HOSTETTER: Hartford-Empire Co., Hartford, Conn.
F. H. RIDDLE: Ceramic Div., Champion Spark Plug Co., Detroit, Mich.

Committee on Film Library

H. E. SIMPSON, *Chairman:* Mellon Institute, Pittsburgh, Pa.
F. B. HOBART: Battelle Memorial Institute, Columbus, Ohio
R. C. PURDY

Committee on Dust Hazard (temporary)

F. C. FLINT, *Chairman:* Hazel-Atlas Glass Co., Zanesville, Ohio
EDWARD SCHRAMM, Onondaga Pottery Co., Syracuse, N. Y.
J. C. HOSTETTER, Hartford-Empire Co., Hartford, Conn.
L. H. MILLIGAN, Norton Company, Worcester, Mass.

ROSTER OF FOUNDERS GROUP OF THE INSTITUTE OF CERAMIC ENGINEERS OF THE AMERICAN CERAMIC SOCIETY

ALBERY, DUANE FAXON: Columbus, Ohio
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ANDERSON, YNGVE RAGNVALD: Toronto, Canada
ANDREWS, ANDREW IRVING: Urbana, Ill.
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ARNOLD, THOMAS MOORE: Cincinnati, Ohio

BABCOCK, PAUL RANDALL: Frenchtown, N. J.
BALDAUF, EARL E.: Anderson, Ind.
BARRINGER, LAWRENCE EUGENE: Schenectady, N. Y.
BAUMANN, HENRY NICHOLAS, JR.: Niagara Falls, N. Y.
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BIRCH, RAYMOND EMBREE: Pittsburgh, Pa.
BLEININGER, ALBERT VICTOR: Newell, W. Va.
BLEWETT, JOHN BURDETT: Wellsville, Ohio
BOEKER, VICTOR WILLIAM: Edwardsville, Ill.
BOYD, ROBERT CRAIG: Louisville, Ky.
BOZMAN, WILLIAM DALE: Loveland, Colo.
BRADLEY, RICHARD SMITH: Mexico, Mo.
BRAUNER, ERNEST RICHARD: Chicago, Ill.
BROWN, LAWRENCE HERBERT: East Liverpool, Ohio
BUCK, KENNETH EDWARD: Philadelphia, Pa.
BUCKNER, ORELLO SIMMONS: Westboro, Mass.
BURDICK, PERCY WITTER: Niagara Falls, N. Y.

CAMPBELL, ROBERT MORRELL: Alfred, N. Y.
CARRUTHERS, JOHN LITSTER: Columbus, Ohio
CLARE, ROBERT LINN: Perth Amboy, N. J.
CLARK, ROLAND JOSEPH: Philadelphia, Pa.
COLE, SANDFORD STODDARD: South Amboy, N. J.
COLLINS, PAUL F.: Columbus, Ohio
COSS, HAROLD THORNTON: Manville, N. J.
COX, PAUL ERNEST: Ames, Iowa
CRAMER, WILLIAM EDWARD: Columbus, Ohio
CRANDALL, JAMES RALPH: Maurer, N. J.
CRAWFORD, JAMES LOUIS: St. Louis, Mo.
CRAWFORD, GEORGE EUGENE: Ford City, Pa.

DANIELSON, RALPH RAYMOND: Carteret, N. J.
DAVIS, HARRY EDWARD: Perth Amboy, N. J.
DODD, CHARLES MITCHENER: Rolla, Mo.
DORNBACH, WILLIAM EDWARD: San Francisco, Calif.
DUBOIS, HASCALL BURTON: Trenton, N. J.

FELLOWS, ROGER LEE: Cicero, Ill.
FESSLER, ALBRA HENRY: Flint, Mich.
FISK, HENRY GRUNSKY: San Andreas, Calif.
FITZGERALD, ALEX EDWARD: Philadelphia, Pa.
FOSTER, HARRY DAVID: Massillon, Ohio
FRITZ, EDWIN HENRY: Derry, Pa.
FULTON, CLARENCE EDWARD: Creighton, Pa.

GARVE, TREUMUND WALTER: Columbus, Ohio
GEIGER, CHARLES FRANCIS: Perth Amboy, N. J.
GERBER, ALBERT CARL: Metuchen, N. J.
GLADDING, AUGUSTUS LEMUEL: San Jose, Calif.
GOODRICH, HOBERT REED: Los Angeles, Calif.
GOULD, ROBERT EDWARD: Norris, Tenn.
GREAVES-WALKER, ARTHUR FREDERICK: Raleigh, N. C.
GREGORIUS, JOSEPH SCOTT: Tarentum, Pa.

HAGAR, DONALD: Zanesville, Ohio
HANNA, HAROLD HOWARD: Crystal City, Mo.
HANNA, RALPH E.: Anderson, Ind.
HARCOURT, EDWARD LENTZ: Johnstown, Pa.
HEATH, FREDERICK, JR.: Worcester, Mass.
HENRY, ARTHUR VAN: Atlanta, Ga.
HEPPLEWHITE, JAMES WILSON: East Liverpool, Ohio
HEWITT, LOWELL CLELAND: St. Louis, Mo.
HUGHES, WALTER MCKINNIE: Zanesville, Ohio
HILL, ERCELL CHANNING: Philadelphia, Pa.
HORNUNG, MARTIN ROBERT: New Castle, Pa.
HOSTETTER, JOHN CLYDE: Hartford, Conn.
HOUSER, VICTOR FLEMING: Los Angeles, Calif.

INNES, DAVID HANSON: New Lexington, Ohio
IRVINE, GEORGE COLTON: Niagara Falls, Ontario, Canada

JOHNSON, GUSTAF ADOLPH: Dover, Ohio

KAUTZ, KARL: Massillon, Ohio
KENT, GEORGE GRAHAM: Peru, Ind.
KENT, NATHANIEL JOHNSON: New York, N. Y.
KING, ROBERT MAYNARD: Columbus, Ohio
KLINEFELTER, THERON ALBERT: Washington, D. C.
KOOS, EUGENE KENNETH: Clarksburg, W. Va.
KRANER, HOBART MCKINLEY: Bethlehem, Pa.
KREHBIEL, JUNIUS FREDERICK: Pataskala, Ohio
KUECHLER, ADOLPH HARMON: Tiffin, Ohio

LAIRD, CHARLES: Neodesha, Kan.
LEE, P. WILLIAM: Chicago, Ill.
LEIBSON, JACOB S.: Schenectady, N. Y.
LINTZ, ELMO HENRY: East Liverpool, Ohio
LONG, RUSSELL NEVIN: Taylor, Greenup County, Ky.
LOOMIS, GEORGE ALLEN: Columbus, Ohio

LOUDEN, ROBERT HANDLEY: Anderson, Ind.
LUKS, DANIEL WYNKOOP: Frenchtown, N. J.

MACDONALD, ROBERT WESLEY: Wheeling, W. Va.
MADDOCK, JOHN BROOMFIELD: Easton, Pa.
MALM, ARTHUR THEODORE: Worcester, Mass.
MARLEY, HENRY EDWARD: Cincinnati, Ohio
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MCCANN, DONALD MILES: Akron, Ohio
MCDOWELL, SAMUEL JOHN: Keasbey, N. J.
MCELROY, ROY HARDIN: Dayton, Ohio
MCKINLEY, JOHN MILTON: Cleveland, Ohio
MCMAHON, JOHN FRANCIS: Alfred, N. Y.
MCVAY, THOMAS NEWKIRK: University, Ala.
MERRITT, CLARENCE WILLIAM: Alfred, N. Y.
MERRITT, LESTER MICHAEL: Columbus, Ohio
MINTON, GERALD ZIEGLER: Creighton, Pa.
MONTGOMERY, EARLE TOWSE: Franklin, Ohio
MORGAN, WILLIAM RAY: Urbana, Ill.
MORRIS, GEORGE DELBERT: New Castle, Pa.
MOULTON, DONALD ALONZO: Terra Haute, Ind.
MUNDY, OTTO S.: Chicago, Ill.
MURPHY, REMINGTON MORRIS: Keyport, N. J.

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PARMELEE, CULLEN WARNER: Urbana, Ill.
PENCE, FORREST KIZER: Paducah, Ky.
PFEIFFER, WILBUR HENRY: Dayton, Ohio
PHILLIPS, JAMES GORDON: Ottawa, Canada
PLACE, TOM MAXSON: Mt. Clemens, Mich.
PLANJE, CHRISTIAN WILLIAM: Lincoln, Calif.
PLUSCH, HERMAN ARTHUR: Philadelphia, Pa.
PURDY, ROSS COFFIN: Columbus, Ohio

RICE, BRYAN AUGUSTUS: Rochester, N. Y.
RIDDLE, FRANK HARWOOD: Detroit, Mich.
ROBSON, JAMES THOMAS: Cleveland, Ohio

SCHORY, RALPH MILLER: Minerva, Ohio
SCHOTTS, WALTER HENRY: Crooksville, Ohio
SCHURECHT, HARRY GEORGE: Alfred, N. Y.
SCOTT, MURRAY RANSFORD: Rochester, N. Y.
SIMPSON, HAROLD ELLIS: Pittsburgh, Pa.
SMITH, CHARLES ADELBERT: Mexico, Mo.
SOSMAN, ROBERT BROWNING: Kearny, N. J.
SPROAT, IRA ELMER: New York, N. Y.
STEINHOFF, FREDERICK LOUIS: Chicago, Ill.
STEIF, WILLARD CHARLES: Mt. Clemens, Mich.
STOUT, WILBER: Columbus, Ohio
STULL, RAY THOMAS: Washington, D. C.
SWAIN, STEPHEN MCKEE: Cleveland, Ohio
SWEELY, BURTON T.: Cicero, Ill.
SYLVESTER, GEORGE RICHARD: Cleveland, Ohio

TATE, FRANK EDWARD: Mt. Clemens, Mich.
TEFFT, C. FORREST: Columbus, Ohio
TREISCHEL, CHESTER CHARLES: New York, N. Y.
TROSTEL, LOUIS JACOB: Baltimore, Md.
TWELLS, ROBERT: Fostoria, Ohio

VAUGHAN, WILLIAM HARRY: Atlanta, Ga.

WALTON, SAMUEL FORMAN: Blasdell, N. Y.
WATTS, ARTHUR SIMEON: Columbus, Ohio
WEIS, JOSEPH HOWARD: West Paris, Maine
WESTON, RALPH HOLLAND: Slidell, La.
WESTENDICK, FRANK CHARLES: Tallahassee, Fla.
WHITAKER, LORENZO ROBERT: Columbia, S. C.
WHITTEMORE, JOHN WEED: Blacksburg, Va.
WILSON, HEWITT: Seattle, Wash.
WOLFRAM, HAROLD GEORGE: Baltimore, Md.
WORCESTER, WOLSEY GARNET: Saskatoon, Sask., Canada
WRIGHT, EDWARD P.: Newell, W. Va.

AUDIT REPORT AMERICAN CERAMIC SOCIETY FOR 1937

January 28, 1938

The audit of the transactions for the year ending December 31, 1937, has been completed, and submitted herewith are the following schedules showing the results of the operations for the year 1937 and the financial condition as at December 31, 1937:

Schedule I: Statement of Assets and Liabilities as at December 31, 1937.
Schedule II: Income and Expense Statement for year ending December 31, 1937.
Schedule III: Comparative Income and Expense Statement for years ended December 31, 1937 1936, and 1935, and the Division of Income and Expense for the year ending December 31, 1937, as to Publication and General.
Schedule IV: Statement of Securities Owned.

Cash has been audited and reconciled with the bank statement as at December 31, 1937. An adjustment of $3.50 was made to the General Account and one of $0.34 to the Revolving Fund. The amount involved was too small to warrant an effort to reconcile the differences.

Office equipment amounting to $732.52 and Accounts Receivable of $353.86, which were uncollectable, were written off during the year.

The books and records were neatly and accurately maintained and I wish to thank the members of the Society for their willing and gracious coöperation.

—ARTHUR C. JAHN
Public Accountant

STATEMENT OF ASSETS AND LIABILITIES

As at December 31, 1937

ASSETS		
Cash in bank	$7,216.37	
Revolving fund	300.00	
Petty cash	5.00	
TOTAL		$ 7,521.37
United States Securities:		
Savings Bonds	$7,455.10	
Treasury Bonds, 3 3/8% (face value $200)	199.74	
Treasury Bonds, 4 1/4% (face value $200)	209.42	
TOTAL		$ 7,864.26
Accounts receivable	$2,330.14	
Accrued interest receivable	13.03	
TOTAL		$ 2,343.17
Prepaid expenses: 1938 Annual Meeting		305.61
TOTAL ASSETS		$18,034.41
LIABILITIES		
Accounts payable	$2,776.29	
Reserve for Fellow dues	2,661.38	
Building fund	10.00	
Deferred income (prepaid)		
Corporation dues	$2,137.50	
Personal dues	5,756.95	
Subscriptions	1,842.85	
Orton Medallions	16.00	
TOTAL		$9,753.30

TOTAL LIABILITIES	$15,200.97
SURPLUS	2,833.44
TOTAL	$18,034.41

COMPARATIVE INCOME AND EXPENSE STATEMENT

For Years Ended December 31, 1937, 1936, and 1935

		Year 1937	Year 1936	Year 1935
INCOME				
Dues	Corporation	$ 5,624.49	$ 5,001.78	$ 4,678.93
	Personal	19,655.22	17,325.02	16,145.30
TOTAL		$25,279.71	$22,326.80	$20,824.23
Journals	Year 1937	5,163.00	4,356.26	5,020.27
	Previous years	950.96	1,133.71	858.30
TOTAL		$ 6,113.96	$ 5,489.97	$ 5,878.57
		1937	1936	1935
Advertising		10,816.61	10,932.33	8,506.71
Miscellaneous			40.44	185.34
Society Key		7.76	18.32	
Reprints (net)		209.07	128.15	124.90
Annual Meeting				460.16
Contributions				5.00
Interest		17.31		81.26
TOTAL		$11,050.75	$11,119.24	$ 9,363.37
TOTAL INCOME		42,444.42	38,936.01	36,066.17

EXPENSES			
Cost of publications	$16,181.35	$15,646.82	$13,488.22
Abstracts	801.23	847.38	666.94
Editorial Office	721.11	1,274.93	1,008.44
TOTAL	$17,703.69	$17,769.13	$15,163.60
Salaries	$16,837.50	$15,372.29	$13,120.76
Secretary's office expense	1,555.63	1,910.40	1,256.94
Postage	1,410.11	1,256.17	1,547.23
Office rental	960.00	960.00	960.00
Interest	121.11	97.95	
Annual Meeting	439.03	365.92	
Divisional expense	217.25	257.93	196.02
Traveling	644.62	847.53	
Miscellaneous	167.71	307.33	145.63
Bad accounts	353.86	120.00	
President's expense	6.38		
Structural Clay Products Research Foundation	381.69		
TOTAL	$23,094.89	$21,495.52	$17,226.58
Write-Offs:			
Office Equipment	$ 732.52		$ 1,607.82
Publications			1,827.95
TOTAL	$ 732.52		$ 3,435.77
TOTAL EXPENSES	$41,531.10	$39,264.65	$38,825.95
GAIN	$ 913.32	$ 328.64	$ 240.22

SECRETARY'S MESSAGE

WHY REGISTRATION FEES AT MEETINGS AND SOME WORTHWHILE FACTS REGARDING THE AMERICAN CERAMIC SOCIETY

(1) Founded forty years ago in Orton Hall, Ohio State University, with Edward Orton, Jr., as Secretary.

(2) Reorganized in 1918 to provide for Divisions, Local Sections, Student Branches, and Standing Committees.

(3) During the first twenty years, the Society published nineteen volumes of annual *Transactions* (1899–1917), a translation of Seger's Writings, Ceramic Calculations, and promoted ceramic research in Federal Bureaus, Geological Surveys, and Universities. During the second twenty years, the Society published twenty volumes of a monthly *Journal*, sixteen volumes of *Ceramic Abstracts*, sixteen volumes of *The Bulletin*, several Bibliographies, Book Lists, and Compilations of Phase-Rule Diagrams. Promotion of informational activities directly and in collaboration with other technical societies has been continued with increasing intensity and success.

(4) This Society has a well-equipped secretarial and editorial office; an efficient staff; a library of 883 cloth-bound and many more paper-bound books and pamphlets; a ceramic collection of more than 1300 pieces; a gallery of 640 photographs of individual ceramists and several group pictures all framed; a stock of *Transactions*, *Journals*, *Ceramic Abstracts*, and *The Bulletin;* and a file of several periodicals covering sixteen years, all of this wholly paid for and not listed as assets on the books.

(5) The *Journal* containing research reports and *The Ceramic Abstracts* have increased in quantity and quality and in world-wide reading and coverage.

(6) The financial statement for 1937 showed a profit of $913.32 for the year and bonds covering all write-offs. Financially, the Society is a wee better than "even with the board."

(7) Each activity should be self-supporting. The publications are nearly so when $6.00 per member is accredited. The Annual Meetings have seldom been self-supporting. The total disbursements for the 1937 Meeting were $3273.18, and the income from registration was $2848.26, leaving a deficit of $424.92. This is why there is a registration fee of $3.00.

Meetings are golden opportunities, not alone for acquiring information but also for making personal contacts with persons with whom one can make profitable exchanges throughout the year.

$3.00 FOR A WEEK OF EDUCATIONAL OPPORTUNITIES

Your Society will keep on increasing in substance and in effectiveness, but only at the rate and to the extent that its Meetings, publications, and activities are financed.

CAN YOU NAME A MORE SAFE AND PRODUCTIVE INVESTMENT?

Coming Together + Keeping Together + Working Together adds up to individual and collective success

On to New Orleans and Way Beyond

Fortieth Annual Meeting, March 27–April 2

with Its

Programs of Unprecedented Values

Will Be

Foretaste of More Valuable

Meetings, Activities, and Publications

Marking 1938 a Year of

Largest Step Forward in

Ceramic Arts, Science, and Technology

Your Part?

Sell this substantial and progressive Society to your ceramic associates and acquaintances.

MEMBERSHIP RECORD

Date of Record	Members Paid		Deferred	Subscriptions	Monthly Sales	Total Circulation
	Personal	Corporation				
December 20, 1936	1452	196				
December 22, 1937	1713	220	12	523	220	2688
January 22, 1938	1712	220	12	530	220	2694
February 18, 1938	1728	217	15	540	220	2720

All resignations have been subtracted. Only those having "cash on the counter" are counted. Those not fully paid by March 15 will be cut off. Will you allow a shrinkage in the number of your coöperators?

ROSTER CHANGES DURING FEBRUARY*

Corporation

GLADDING, McBEAN & Co., Attn. M. F. Johansen, 1275 Harrison St., San Francisco, Calif. (Lincoln, Placer County, Calif.)

Personal

ALBERY, D. F., Edward Orton, Jr., Ceramic Foundation, 1445 Summit St., Columbus, Ohio. (Evanston, Ill.)

BOWES, URBAN E., Owens-Illinois Glass Co., 1700 N Westwood Ave., Toledo, Ohio. (Perrysburg, Ohio)

CUNLIFFE, JACK A., McCurdy Supply Co., Ltd., 1034 Arlington St., Winnipeg, Man., Canada. (Vancouver, B.C., Canada)

EVERHART, J. OTIS, Kentucky Fire Brick Co., Haldeman, Ky. (Columbus, Ohio)

GIBSON, R. L., 216 N. Jefferson St., New Castle, Pa. (Kittanning, Pa.)

GREENSTREET, EDWARD C., Chicago Vitreous Enamel Product Co., Cicero, Ill. (Baltimore, Md.)

GRIFFIN, CARL H., Norton Company, Worcester, Mass. (Germany)

HARVEY, EDWIN T., Hotel Vandalia, Vandalia, Mo. (Goldfield, Iowa)

LOWE, JOHN L., 817 N. Cedar, Lansing, Mich. (Muskegon Hts., Mich.)

PIERCE, R. H. H., 1800 Farmers Bank Bldg., Pittsburgh, Pa. (Homestead, Pa.)

PINCUS, ALEXIS, Dept. of Ceramics, Pennsylvania State College, State College, Pa. (Southbridge, Mass.)

ROBERTSON, CAMPBELL, E. I. du Pont de Nemours & Co., Perth Amboy, N. J. (Wilmington, Del.)

SOLOMON, ROBERT, 957 Simpson St., Bronx, N. Y. (Muskegon, Mich.)

WILLIAMS, FRANCIS J., National Pigments & Chemical Co., 722 Chestnut St., St. Louis, Mo. (Pittsburgh, Pa.)

Student

FRÉCHETTE, VAN DERCK, Box 2, Alfred, N. Y. (Ottawa, Ont., Canada)

RIGGS, SOLOMON G., JR., 704 N. Jefferson St., Mexico, Mo. (Raleigh, N. C.)

*Address in parentheses is the former address.

NEW MEMBERS

Corporation

*NATIONAL ENGINEERING Co., L. B. Knight, Jr. (voter), 549 W. Washington Blvd., Chicago, Ill.

Personal

BLAIR, CLAUDE C., Metropolitan Paving Brick Co., Canton, Ohio; president.

BRIAN S. DOUGLAS, Paper Makers Importing Co., 640 N. 13th St., Easton, Pa.

BURCH, OSCAR G., 1700 N. Westwood Ave., Toledo, Ohio; chemist, Owens-Illinois Glass Co.

CHAMBERLAIN, JAMES M. W., P. O. Box 350, Akron, Ohio; vice-president, United States Stoneware Co.

FREED, MEYER L., 120 S. Cliff St., Ansonia, Conn.; technical director, Mullite Refractories Co.

HOMESTEAD, ROBERT, Evans Case Co., Inc., 21 East St., North Attleboro, Mass.; chemist.

HOWIE, THOMAS W., 53 Firth Park Road, Sheffield, England; research worker, United Steel Co., Ltd.

JOHNSON, J. A., Service Engineers, Ltd., Leek New Rd., Cobridge, Burslem, Stoke-on-Trent, England.

*KAYSER, JULIUS A., 1711 Ambassador Bldg., St. Louis, Mo.; refractory engineer, Laclede-Christy Clay Products Co.

KIDNER, V. H., 166 E. Park St., Westerville, Ohio; engineer, Kaul Clay Mfg. Co., Toronto, Ohio.

LAMPMAN, C. MAJOR, JR., 17 Reynolds St., Alfred, N. Y.; assistant, New York State Experiment Station.

LEA, ARTHUR C., Residence National Smelting Co., Ltd., Avonmouth, Bristol, England; refractory technologist.

PIERCE, JAMES B., JR., Standard Ultramarine Co., Huntington, W. Va.; manager.

SUMRELL, FERRALL N., 395 Stratford Rd., Brooklyn, N. Y.; supervising engineer, Clarostat Mfg. Co., Inc.

STUFFT, PAUL C., 2802 Inglewood Ave., Baltimore, Md.; laboratory manager, Porcelain Enamel & Mfg. Co.

TREVOR, JOHN F., Moira Rd., Woodville, nr. Burton-on-Trent, England; director, John Knowles & Co., Ltd.

*Indicates former member of the Society rejoining.

Student

BERRY, HERBERT G., Ohio State University.

BRAMLETT, WILLIAM P., JR., Pennsylvania State College.

BURNS, J. D., Georgia School of Technology.

CARPENTER, JAMES H., Georgia School of Technology.

COWLIN, KENNETH S., Pennsylvania State College.

EBRIGHT, MORT W., Ohio State University.

HENDERSON, JOHN H., Ohio State University.

LULL, STANLEY E., Ohio State University.

LYNN, BERT M., New York State College of Ceramics.

NIKLEWSKI, BRAUNISLAW, JR., University of Illinois.

VASQUEZ, J. PAUL F., North Staffordshire Technical College.

WHITEHEAD, MERLIN H., University of Illinois.

MEMBERSHIP WORKERS' RECORD

Corporation

Office	1

Personal

L. C. Athy	1	R. B. Keplinger	1
A. V. Bleininger	1	W. J. Rees	1
W. K. Carter	1	S. J. Slaven	1
J. H. Chesters	1	R. B. Sosman	1
L. C. Hewitt	1	Office	6
H. H. Holscher	1		

Student

A. I. Andrews	2	E. C. Henry	2
A. E. Baggs	1	Lane Mitchell	2
R. M. Campbell	1	A. S. Watts	2
Norman Echavarria	1	Office	1
		Grand Total	**29**

THE AMERICAN CERAMIC SOCIETY TRUSTEES AND OFFICERS FOR 1937–1938

President: R. B. Sosman, United States Steel Corp., Research Lab., Kearny, N. J.

Vice-President: V. V. Kelsey, Trenton, N. J.

Treasurer: C. Forrest Tefft, The Claycraft Co., Columbus, Ohio

Secretary-Editor: Ross C. Purdy, 2525 North High St., Columbus, Ohio

Past-President: F. C. Flint, Hazel-Atlas Glass Co., Zanesville, Ohio

Past-President: J. M. McKinley, North American Refractories Co., Cleveland, Ohio

TRUSTEES FROM INDUSTRIAL DIVISIONS*

Art: L. E. Barringer, General Electric Co., Schenectady, N. Y. (1940)

Enamel: H. G. Wolfram, Porcelain Enamel Mfg. Co., Baltimore, Md. (1940)

Glass: J. T. Littleton, Corning Glass Works, Corning, N. Y. (1938)

Materials and Equipment: G. H. Brown, Rutgers University, New Brunswick, N. J. (1939)

Refractories: C. E. Bales, Ironton Fire Brick Co., Ironton, Ohio (1940)

Structural Clay Products: J. L. Child, Hancock Brick & Tile Co., Findlay, Ohio (1939)

Terra Cotta: J. L. Carruthers, Ohio State Univ., Columbus, Ohio (1939)

White Wares: P. D. Helser, General Ceramics Co., New York, N. Y. (1938)

* Date of expiration of term of office in parentheses.

DIVISION OFFICERS

Art
Chairman: C. M. Harder, N. Y. State College of Ceramics, Alfred, N. Y.
Secretary: M. L. Fosdick, N. Y. State College of Ceramics, Alfred, N. Y.

Enamel
Chairman: F. R. Porter, Inland Steel Co., Hammond, Ind.
Secretary: B. J. Sweo, Ferro Enamel Corp., Cleveland, Ohio

Glass
Chairman: A. N. Finn, National Bureau of Standards, Washington, D. C.
Secretary: S. R. Scholes, N. Y. State College of Ceramics, Alfred, N. Y.

Materials and Equipment
Chairman: J. E. Eagle, Vitro Manufacturing Co., Pittsburgh, Pa.
Secretary: G. C. Betz, Foote Mineral Co., Philadelphia, Pa.

Refractories
Chairman: H. M. Kraner, Bethlehem Steel Co., Bethlehem, Pa.
Secretary: S. F. Walton, Exolon Co., Blasdell, N. Y.

Structural Clay Products
Chairman: D. A. Moulton, 715 Mulberry St., Terre Haute, Ind.
Secretary: T. W. Garve, 314 King Ave., Columbus, Ohio

Terra Cotta
Chairman: H. E. Davis, Federal Seaboard Terra Cotta Co., South Amboy, N. J.
Secretary: D. F. Albery, Edward Orton, Jr., Ceramic Research Foundation, Columbus, Ohio.

White Wares
Chairman: R. F. Geller, National Bureau of Standards, Washington, D. C.
Secretary: J. W. Hepplewhite, Edwin M. Knowles China Co., Newell, W. Va.

OFFICERS OF THE FELLOWS

Dean: Emerson P. Poste, 309 McCallie Ave., Chattanooga, Tenn.

Associate Dean: Louis Navias, General Electric Co., Schenectady, N. Y.

Secretary: R. K. Hursh, University of Illinois, Urbana, Ill.

LOCAL SECTIONS

Baltimore-Washington
Chairman: G. H. Spencer-Strong, Porcelain Enamel & Mfg. Co., Baltimore, Md.
Secretary: J. D. Tetrick, Baltimore Enamel & Novelty Co., Baltimore, Md.

Central Ohio
Chairman: M. C. Shaw, Edward Orton, Jr., Ceramic Research Foundation, Columbus, Ohio
Secretary: T. W. Garve, 314 King Ave., Columbus, Ohio

Chicago
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ANNUAL REPORTS OF STANDING COMMITTEES

THE PRESENT STATUS OF CERAMIC ENGINEERING CURRICULA

Report of the Curricula Committee of the Association of Ceramic Educators

By M. E. Holmes, *Chairman*

This report presents the findings of the Curricula Committee which was appointed last year by A. S. Watts, President of the Association of Ceramic Educators, to determine wherein ceramic engineering curricula at the various ceramic schools differ from one another at this time and to determine the probable trend in the development of these curricula as indicated by the policies prevailing at the various institutions. The report does not deal with ceramic-technology curricula but exclusively with curricula labelled either ceramic engineering or general ceramic technology and engineering.

A questionnaire in the form of an outline of curricula subjects was sent to the head of each ceramic school in the United States, with a request that the percentage of the entire course devoted to each subject be tabulated. The following institutions coöperated in this undertaking: North Carolina State College, New York State College of Ceramics, Ohio State University, University of Illinois, University of Missouri School of Mines, Rutgers University, University of Washington, Iowa State College, Pennsylvania State College, and the Virginia Polytechnic Institute.

One of the most important aspects of the data thus obtained is that it is authoritative by reason of the fact that it was reported by the responsible head of each ceramic school and was not obtained by any one person calculating the data from catalogues or other sources. It presents accurately the present status of ceramic engineering curricula and brings up to date the work that Professor Watts did along the same line in 1925.[1]

The data are summarized in Table I, a key number being used for each institution. The figures represent the percentage of the entire course devoted to each subject and labelled as such in the catalogues. The figures in parentheses and preceded by a + sign show the amount of the subject matter, indicated by the line items, which is given in other courses but not labelled as such. Certain details of some of the curricula could not be presented in the table so they are appended in the form of notes following the table.

Appendix to Table I

Institution II

* Specialization and Electives.

Electives are divided into 7 hours of approved electives and 6 hours of technical options.

"Technical Options" include courses in glass, cements, enamels, ceramic microscopy, and ceramic design, in physical chemistry, chemistry of colloids, chemical technology, metallurgy, and metallography; contracts and specifications; engineering geology; steam and air machinery, heat engines; analytical machines, resistance of materials; principles of mining; theoretical mechanics, radioactivity, nuclear physics, and X-rays.

"Approved Electives" include the above "Technical Options" and, in addition, any course in the Colleges of Engineering, Liberal Arts and Sciences, and Commerce and a few courses in Fine and Applied Arts, Education, and the Library School.

Institution III

Course in "Valuations" is required, giving 3 hours credit.

* These courses are optional.

*(2) Item 14 (*c*) is set at 0% because it is understood that this is only specialization, as far as the student is concerned, except in rare instances.

*(3) Item 14 (*d*) is satisfied by the C.E. courses in steel and concrete design, plus a steady drill on any and all plant designs in all work in fundamental ceramics. Five credits in Steel Structures Design and 5 credits in Concrete Design, amounting to 4.7% are *required;* this runs the total up to 105%.

*(4) Item 18 is generally absorbed by 2.7% Petrography, plus 3.8% Advanced Physics, divided between Light and Heat, plus 2.8% Advanced Physical Chemistry divided between X-ray and Spectrographic Analysis and Miscellaneous.

Institution IV

* Grand total of 105.33 should have subtracted from it 8 hours or 5.33%, making a total of 100.00.

The student may choose between 8 hours Petrography and 8 hours Steam Power Plants in the senior year.

Institution V

* Electives do not include engineering courses.

Institution VI

* Includes 10 hours or 4.2% for summer experience.

*(2) Minimum; practically every graduate will have from 2 to 6% excess.

*(3) Science-Physical Education—Survey of Engineering.

Institution VII

* Mechanics and Heat, 2.7. Sound and Electricity and Magnetism, 2.7.

*(2) Elective.

Three hours must be chosen from each of the following four groups, with the provision that if either a Foreign Language or Military Science and Tactics are chosen, they must be continued for two years.

[1] A. S. Watts, "Development of a Ceramic Course to Meet the Demands of the Industry," *Jour. Amer. Ceram. Soc.*, **8** [2] **42–44** (1925).

Group (1)	
Engineering Economics Industrial Organization Military Science and Tactics Foreign Language	3 hr.
Group (2)	
Technical English Military Science and Tactics Foreign Language	3 hr.
Group (3)	
Ceramic Special Problems Military Science and Tactics Foreign Language	3 hr.
Group (4)	
Identical with Group (3)	
Ceramic Fundamentals	
Elements of Ceramics	6 hr.
Ceramic Materials	6 "
Ceramic Laboratory Technique	3 "
Bodies and Glazes	6 "
Ceramic Design	
Industrial Ceramics	3 hr.
Ceramic Specialization	
Structural Clay Products and Cements	3 hr.
Refractories	3 "
Decorative Ceramics	6 "
Glasses	3 "
Enamels	3 "

Institution VIII

* Elective, but German practically required.

*(2) R. O. T. C. and Physical Education.

Calculating an Average Curriculum

The data in Table I were averaged for each item and then modified to the slight extent necessary to make it total 100%. The hypothetical curriculum thus obtained is given in Table II.

TABLE II

AVERAGE CURRICULUM

(1) Mathematics	
(*a*) Algebra	2.35
(*b*) Trigonometry	1.97
(*c*) Analytical Geometry	2.59
(*d*) Differential Calculus	2.25
(*e*) Integral Calculus	2.41
Total	11.57
(2) Chemistry	
(*a*) General	5.28
(*b*) Analytical	5.52
(*c*) Physical	3.76
Total	14.56
(3) Physics	
(*a*) Mechanics	1.95
(*b*) Sound	1.07
(*c*) Heat	1.29
(*d*) Electricity, Magnetism	1.47
(*e*) Light	1.32
Total	7.10
(4) English	
(*a*) Rheotoric and Composition	3.30
(*b*) Literature	1.10
(*c*) Professional English	1.49
Total	5.89
(5) Geology	2.88
(6) Mineralogy	1.79
Thermochemical Mineralogy	0.12
Crystallography	0.20
(7) Mechanics	4.66
(8) Mechanical Engineering	1.39
Power Plants	0.54
(9) Electrical Engineering	1.86
(10) Drawing	4.10
(11) Fuels and Combustion	1.24
Principles of Metallurgy	0.20
(12) Petrography	1.84
(13) Pyrometry	0.74
(14) Ceramics	
(*a*) Fundamentals	12.30
(*b*) Specialization	6.48
(*c*) Research	1.97
(*d*) Design	3.18
Total	23.93
(15) Surveying	1.68
(16) Foreign Languages	0.40
(17) Economics	2.45
(18) Electives	7.79
(19) Miscellaneous	3.02

This curriculum represents more nearly than any other curriculum could the consensus of ceramic educators in regard to what should be in a ceramic engineering curriculum at the present time. It does not represent maximum percentage of the course that should be devoted to any one subject, nor the minimum, but a medium or average of extreme thoughts on the subject. As such, even though it does not represent any curriculum now in operation, it has value because it indicates the medium or average of educators' opinion on how much attention each item in the curriculum is entitled to receive.

Discussion of the Individual Items in the Curricula

(1) Mathematics

Maximum 13.62%, minimum 9.2%, average 11.57%. The high figure of 13.62% is for an institution which has a fixed policy of requiring that much mathematics in all of its engineering courses. Although it is admitted that ceramic engineers do not need that much mathematics, there are no prospects of changing it. The institution accounting for the minimum figure of 9.2% reports that it requires extra entrance requirements in mathematics, and if they were added the figure for that institution would be 11.2% instead of 9.2%. With the single exception, therefore, of the one institution which is abnormally high in its mathematics requirements (13.62%), all of the institutions are in remarkably close agreement on the subject and there is no indication of any likelihood of raising or lowering the requirements materially from the 11.5% average.

The distribution of the total time allocated to mathematics between the subjects of algebra, trigonometry, analytical geometry, differential calculus, and integral calculus is uniform. With the exception of one school, which requires no trigonometry, all require nearly the same amount of time for each of these subjects, and the institution which is irregular as to trigonometry makes up for it by excess requirements in analytical geometry, thereby bringing the total for mathematics close to the average.

TABLE I

PERCENTAGES OF THE ENTIRE COURSE DEVOTED TO VARIOUS ITEMS IN THE CURRICULUM†

Curriculum	Institution Number I	II	III	IV	V	VI	VII	VIII	IX	X
(1) Mathematics										
(a) Algebra	2.0	2.27	2.8	3.33	2.46	2.1	3.4	0.0	2.65	2.2
(b) Trigonometry	2.0	1.52	2.36	1.67	2.46	2.1	0.0	2.6	2.65	2.2
(c) Analytical Geometry	3.1	3.03	2.36	1.67	2.46	2.1	3.4	2.6	2.65	2.2
(d) Differential Calculus	2.8	2.27	3.05	2.67	1.64	2.1	2.0	2.0	1.99	1.7
(e) Integral Calculus	2.8	2.27	3.05	2.67	3.27	2.1	2.0	2.0	1.99	1.7
(2) Total	12.7	11.36	13.62	12.01	12.29	10.5	10.08	9.2	11.93	10.0
Chemistry										
(a) General	5.7	5.30	3.8	6.67	4.90	4.2	4.1	5.0	5.75	6.6
(b) Analytical	6.3	6.82	7.5	7.33	3.27	6.74	7.4	4.7	2.65	1.7
(c) Physical	4.9 (+2)	2.27(+1)	5.6*	6.00	2.05 (+2.23)	1.26 (+2.1)	6.1 (+2)	3.0 (+2)	2.65	3.3 (+1.7)
(d) Organic										
(3) Total	16.9	14.39	16.9	20.00	10.22	12.20	17.6	12.7	11.05	11.7
Physics										
(a) Mechanics	2.2	1.89	1.18	2.00	1.64	1.2	2.7*	2.0	2.21	2.2
(b) Sound	1.0	0.95	1.18	1.00	0.22	1.1	2.7*	1.0	0.88	0.6
(c) Heat	1.1	0.95	1.18	2.00	1.41 (+0.50)	1.3 (+1.26)	2.7*	1.5	2.21 (+2)	1.1
(d) Electricity, Magnetism	1.2 (+1)	1.89	2.36	2.00	1.08	1.3	2.7*	1.0	0.88	2.8
(e) Light	2.3 (+1)	1.89	1.18	1.00	0.55	1.4	1.0(+1)	1.0	0.88	1.7
Total	7.8	7.57	7.08	8.00	4.90	6.3	5.4	6.5	7.06	8.4
(4) English										
(a) Rhetoric and Composition	2.22	4.55	4.2	4.00	3.69	2.78	4.1	3.0	3.98	0.0
(b) Literature	2.0			4.00	1.23	1.0	0.0		2.65	0.0
(c) Professional English	1.4		1.0		3.69	1.26	0.0	2.0	2.65	1.7 (+1.1)
Total	5.6	4.55	5.2	8.00	8.61	5.04	4.1	5.0	9.28	1.7
(5) Geology	2.1 (+1)	2.27	5.6*	2.67	1.23	2.1	3.0	4.0	2.65	2.8 (+1.1)
(6) Mineralogy	2.1 (+0.5)		1.9	1.33	1.23 (+1.0)	1.68	1.0 (+1)	3.0	2.65	2.8
(a) Thermochemical Mineralogy					1.23					
(b) Crystallography							2.0			
(7) Mechanics	4.3	6.82	5.0	4.00	3.69	4.2 (+1.5)	2.0	4.0	5.31	6.6
(8) Mechanical Engineering	0 (+1)	2.27		5.33	2.05	0.0(1.26)	0.0	1.5	6.2	1.7 (+1.7)
Power Plants, Steam										
(9) Electrical Engineering	0 (+0.5)	4.55	3.8	3.33	2.46	0.0	0.0	2.5	1.77	0.0
(10) Drawing	4.2 (+2.2)	6.06	3.8	4.00	5.33	5.05 (+2.1)	2.0	1.5	3.54	5.0 (+0.6)
(11) Fuels and Combustion	2.1	0.00 (1.5)			1.23 (+1.0)	1.26 (+1.26)	2.0	3.0	0.44 (+2.5)	2.2 (0.6)
(a) Principles of Metallurgy			0.0	2.00 (+1.3)						
(12) Petrography	2.1	0.00	0.0	5.33*	3.70		2.0	2.0	1.33	1.7
Optical Mineralogy										
(13) Pyrometry	0.7 (+0.5)	0.76	1.4	0.67	0.41 (+0.25)	0.84	2.1		0.44 (+0.5)	0.0 (+0.6)
(14) Ceramics										
(a) Fundamentals	13.4	20.46	13.2	8.67	11.00	19.3*	14.2	9.0	8.41	11.7
(b) Specialization	7.1	0.00*(6)	2.36	6.66	4.69	9.68	12.2	8.0	4.42	8.8
(c) Research	2.8	0.00	0.0*(2)	2.00	2.46	2.52 (+2.1)	0.0*(2)	3.0*(2)	2.21	4.5
(d) Design	4.9	6.06	0.0*(3)	4.67	4.10	6.3	2.0	2.0	1.33	0.0
Total	28.2	26.52	15.56	22.00	23.15	37.8	28.4	22.0	16.37	25.1
(15) Surveying	2.1	1.52	1.4	2.67	1.23	2.1	0.0	3.0	0.88	1.7
(16) Foreign Languages	0.0	0.00	0.0		Elective		0.0*(2)	4.0*	0.0	0.0
(17) Economics	2.8	0.00	4.2	4.00	6.15		0.0		5.31	1.7
(18) Electives	5.6	11.36*	10.8*(4)		7.38*	5.46*(2)	6.5	8.1	13.27	8.3
(19) Miscellaneous	0.0	0.00	3.2		4.69	5.46*(3)	6.5*(2)	9.5	0.44	
Mining and Metallurgy							3.2			8.8
GRAND TOTAL (%)	99.3	100.00	99.46	105.33*	100.28	100.0	100.0	100.0	99.92	100.0
Required for Graduation	147 semester hours	142 credit hours		150 credit hours	240 term credits	238 quarter hours	155 credits	148 credit hours	222 quarter hr. credit	180 quarter hr. credit

† See Appendix and Discussion for information on details.

(2) Chemistry

Maximum 20%, minimum 11.10%, average 15.56%. The agreement between the various institutions on the chemistry requirements is quite as striking as it is in the case of mathematics. The agreement is closer than would be indicated by figures in the table for the reasons given below. In general chemistry, one school which is low reports that one course is required for which no credit is given, thereby lowering its figure for this subject. Another low school reports that it will soon require an additional course in advanced inorganic chemistry. None require any organic chemistry. In the case of analytical chemistry, one school is abnormally low, with 1.7%. Another school abnormally high in this item reports that water and fuel analysis is included which accounts for the high figure. There is more variation in the figures for physical chemistry than the others, but the school with the low figure of 1.26% reports that enough physical chemistry is given in other courses to bring it up to 3.3%. With this correction, the physical chemistry figures range from 2.65 to 6%. The trend toward more physical chemistry is evident, and it is probable that within a few years the high figure of 6% will become more nearly the average. This would, of course, raise the percentage of the entire ceramics course devoted to chemistry in general. At present, however, there is close agreement in devoting about 15% of the entire course to chemistry.

(3) Physics

Maximum 8.4%, minimum 4.9%, average 6.9%. With the exception of the one high figure and the one low figure, the figures for the other eight ceramic schools are in close agreement. Five of them are between 7% and 8%. The low figure of 4.9% becomes 5.4% when physics given in other courses is included. Likewise the distribution of the total time for physics between the various divisions of the subject is close. There is little disagreement between ceramic educators on the status of physics in ceramic training, and that agreement includes *increasing* instead of *decreasing* the emphasis on this subject. The indications are that, before many years, the average figure of 6.9% will be materially increased and that the increase will be quite uniform among the various schools.

(4) English

Maximum 9.28%, minimum 1.7%, average 5.89%. There is more disagreement on the subject of English than on the previously mentioned subjects. The disagreement, however, is not as great as might be inferred from the figures. With the exception of the one school which reports 1.7%, the lowest figure is 4.1%. Two of the schools reporting a high figure state that the ceramics department disapproves of it, but no change can be made on account of a general policy of the institution. One school, rather low in English requirements, takes the stand that the high schools should take care of instruction in English to a greater extent than they do now. As to the relative importance of rhetoric and literature, a slight majority is in favor of emphasizing rhetoric. A sharp difference of opinion prevails as to the merits of professional English. Some emphasize that it is very important and others take the stand that the essentials of English are the same whether it be called professional or otherwise.

There seems to be no prospect of closer agreement on the subject of English than that indicated by the figures given above. It is significant, however, that it is allocated a rank considerably below mathematics and chemistry.

(5) Geology

Maximum 5.6%, minimum 1.23%, average 2.88%. All schools agree that geology is an essential part of a ceramic training and, with the exception of one very low and one very high in its geology requirements, they agree closely on the average figure of about 3%. The school reporting the high figure makes it optional with other courses.

(6) Mineralogy

Maximum 3.0%, minimum 0%, average 1.79%. With the exception of one school all require mineralogy, and they agree closely on the average figure of about 2%. Some emphasize it as one of the most important and most fundamental courses in ceramic training. The indications are that it will be more and more emphasized. Crystallography and thermochemical mineralogy are required as special and distinct courses at one institution only.

(7) Mechanics

Maximum 6.6%, minimum 2%, average 4.66%. All schools agree that mechanics is a fundamental and essensential course in a ceramic engineering training. With the exception of one institution high in its requirements and one low in its requirements, all agree closely on the average figure of about 4.5%.

(8) Mechanical Engineering

Maximum 6.2%, minimum 0%, average 1.39%. There is almost complete disagreement on the need of mechanical engineering in a ceramic training. Five schools require none and five require it in amounts ranging up to 6.2%. With the exception of the institution requiring the high figure, none requires more than 2.27%. Two of these make it optional. Another takes the stand that because electric power is the vogue there is no need of instruction in power plants. Another condemns it altogether; another considers it an essential course. The consensus seems to be that it is of little value in a ceramic engineering course and that it is destined to become less so.

(9) Electrical Engineering

Maximum 4.55%, minimum 0%, average 1.86%. The situation as to electrical engineering is much the same as for mechanical engineering. Six schools require it and four do not. It would seem, therefore, that it is in somewhat more demand than mechanical engineering. One school considers it essential. Two give it merely because of the policy of the institution of having all engineers take it. Another does not require it because the shortest E.E. course that the E.E. department would give would constitute 3.35% of the ceramic course, and the ceramic department does not consider it entitled to that much consideration. The indications are that electrical engineering is destined to be less and less emphasized.

(10) Drawing (Drafting)

Maximum 6.06%, minimum 1.5%, average 4.1%. All schools agree that drafting is an essential part of a ceramic

engineering training. With the exception of one institution requiring a high percentage and one a low percentage, the other eight are in close agreement on a figure of about 4%.

(11) Fuels and Combustion

Maximum 3%, minimum 0%, average 1.24%. All except three schools list fuels and combustion as a requirement and these three schools give some work on this subject in other courses, which amounts to 1.5% in the case of one of them. The school reporting the high figure of 3% requires the large amount of work in this subject because of the exceptional facilities available and not because that much is needed. There is close agreement on a figure of 1.25% for fuels and combustion.

(12) Metallurgy

Only one school requires metallurgy. The consensus is that it should not be a requirement.

(13) Petrography

Maximum 5.3%, minimum 0%, average 1.80%. The line-up in regard to petrography is less well defined than it is in the case of most of the other subjects. Perhaps it is too new to have yet found its bearings. Seven schools require it. Three do not, but of the three, two encourage it as an elective, and many of the students take it. The other school (of the three which do not require it) believes that it should be limited to technology courses. For the seven schools that require it, the percentage is close to 2%. The one exception, where 5.3% is the figure, represents a school that makes it optional with other courses.

The indications seem to be that petrography will quite rapidly become more and more important and widespread in its requirement, with about 2% of the course allotted to it.

(14) Pyrometry

Maximum 2.1%, minimum 0%, average 0.74%. Only one school omits pyrometry altogether. One gives some pyrometry in other courses. The others require it and agree on an allotment of a little less than 1%.

(15) Ceramics

Maximum 37.8%, minimum 15.56%, average 23.93%. With the exception of one high figure and two low ones the others are all close to the average of about 24%. One of the institutions reporting a low figure explains that the curtailment of ceramic work is not a matter of policy but is necessitated by the large amount of time required for military training. The other one keeps the allotment of time to ceramic courses low because the graduates will learn in the industry a lot of what they are taught in the ceramic courses. Only one institution ranks abnormally high in its allotment of time to ceramic courses, and the following comments are submitted by that institution: "Questionnaires to alumni indicate a demand for a high load of ceramic subjects. The industry expects ceramic graduates to produce ceramic results quickly and therefore requires extensive ceramic training. Physical chemistry in part and summer experience in whole are included in the percentage figures for the ceramic courses." In spite of the stand of this one institution, the trend seems to be toward a figure of 25% for ceramic courses.

Although there is good agreement on the total time for ceramic courses, there is considerable disagreement over the segregation of it into fundamentals, specializations, research, and design. All emphasize the fundamentals and allocate much of the ceramic time to it. The percentage of the course assigned to fundamentals, however, varies from 8.41 to 20.46%. Percentages varying from 0 to 9.68% are assigned to specialization. The one school reporting 0% for this item explains that some specialization is realized in courses not so labelled. Another school, rather low in this item, avoids too much specialization as a matter of policy, preferring to concentrate on fundamentals. On the whole, most of the schools maintain the policy of having their students become specialists to a considerable extent. Ceramic research is not required by three of the institutions. The other seven require it in amounts varying up to 4.5%. One institution emphasizes it as one of the most important ceramic courses, taking the stand that students should be taught how to do research. Ceramic design is required in all but two of the schools, the maximum allotment of time being 6.3%. The majority opinion is that fundamentals, specialization, research, and design should be required and that the percentages of the course devoted to them should be about 12%, 6.5%, 2%, and 3%, respectively. The trend, however, is strongly toward emphasizing fundamentals at the expense of the other ceramic courses, keeping the total for all ceramic courses at about 25% of the entire course.

(16) Surveying

Maximum 3%, minimum 0%, average 1.68%. With the exception of one school, all require surveying, but one of the others intends to abandon it. Apparently the trend is toward reduced emphasis on surveying. One school which rates surveying high explains that the high figure is due to the necessity of ceramic students taking surveying with civil engineers and others that require more than the average of about 1¾%.

(17) Foreign Language

Maximum 4%, minimum 0%, average 0.4%. Only one school requires foreign language, although several permit it as an elective. The consensus is that there is no room in a ceramic engineering curriculum for required foreign languages.

(18) Economics

Maximum 6.15%, minimum 0%, average 2.45%. There is much difference of opinion regarding the value of economics. Four schools require no economics and the other six schools vary in their allotment of time to this subject from 1.7 to 6.1%. There is a slight majority in favor of devoting about 2.5% of the course to economics.

(19) Electives

Maximum 13.27%, minimum 0%, average 7.79%. Only one school is abnormally high and that is explained by military courses being included in electives. Only one school is abnormally low and that institution plans to introduce metallurgy as an elective. There is good agreement among the other eight schools on devoting between 7% and 10% of the course to electives. The adaptation of the course to the student's ability does not seem to be a

guiding policy among American ceramic schools. Their training with a somewhat standardized curriculum to meet the needs of the industry seems to be the determining factor.

(20) Miscellaneous

Maximum 9.5%, minimum 0%, average 3.02%. The small percentage of the course allotted to miscellaneous subjects shows that ceramic educators are well agreed upon about 97% of the course.

The General Trend

The probable trend in the development of ceramic engineering curricula is indicated by the following comments from the various schools. One institution comments as follows: "It is possible that within the next two years the time allotted to ceramic fundamentals will be increased 4% or 5% at the expense of mechanical engineering and electives." This school is now abnormally high in these two items. The trend in this case is toward the average curriculum.

Another institution states, "We feel that the teachings of fundamentals is vastly more important than the application of these fundamentals, and future changes in our curriculum will be in that direction." Courses in enamels and X-ray analysis are being introduced in this school. It is already the highest in chemistry and petrography.

The attitude of another institution is expressed as follows: "The probability of changes in our curriculum at this time is slight, but some change will later be made. The tendency is to simplify the number of courses, emphasize fundamentals, decrease factual courses, and increase the content of problem and design courses." This school is now very close to the average in all items except petrography, mineralogy, and ceramic specializations.

The attitude of another school is as follows: "We are trying to avoid too much specialization, particularly in enamels and whiteware. This is upon the advice of industrial people. Our other ceramic courses are set upon a fundamental basis with laboratory work illustrating principles and high-temperature properties rather than manufacturing details."

Another school comments as follows: "The trend will be toward the consolidation into a general ceramic technology and engineering curriculum of the most useful technology and engineering instead of concentrating upon either one. Emphasis will be laid upon fundamentals, especially physical chemistry and the other scientific subjects, such as petrography, X-ray analysis, etc. Mineralogy will have more emphasis. All of this will be done at the expense of allied engineering courses and ceramic specializations. No radical changes will be made at any time, but the policy will be to develop the curriculum conservatively year by year in accordance with the changing needs of the industry."

From these comments, and from such general considerations as the structure of the various curricula, it is easy to detect trends in curricula development toward more thorough groundings in the fundamentals and less specialization, more training in the scientific tools of petrography, X-ray analysis, etc., and less attention to their application, more thorough and complete training in physics and physical chemistry, and reduced emphasis on allied engineering work; and on the whole to lay greater emphasis on technology in all of its aspects.

General Summary

(1) The curriculum in Table II represents the consensus at the present time of ceramic educators regarding what subjects should be included in a ceramic engineering training and the amount of time that should be devoted to each.

(2) Ceramic educators agree that chemistry, mathematics, and physics constitute essential fundamentals and that about 35% of the entire course should be devoted to these subjects.

(3) The tendency is to emphasize physics and chemistry, particularly physical chemistry, with no indication that greater emphasis be placed on mathematics.

(4) There is complete agreement on English, geology, mechanics, and drawing being essential courses, but the emphasis placed upon them is much less than that placed upon mathematics, chemistry, and physics.

(5) The majority of educators consider mineralogy, fuels and combustion, petrography, surveying, pyrometry, and economics to be essential. A minority are of the opinion that one or more of them may be omitted. None would allocate more than 6% of the course to any one of these subjects.

(6) There is almost an equal division of opinion regarding the merits of mechanical and electrical engineering.

(7) Foreign languages are not considered essential.

(8) The attitude toward electives is variable, but practically all educators favor including electives to some extent, the maximum amount being 13%. It is evident that a ceramic engineering training is too exacting to permit large flexibility in adapting the training to the individual needs of the students.

(9) There is agreement on devoting about 25% of the entire course to ceramic subjects. There is also agreement on devoting about one-half of this time to the fundamentals and the remainder to specialization, research, and design. The tendency is to emphasize the fundamentals even more at the expense of the specializations.

—M. E. HOLMES, *Chairman, Curricula Committee*
A. F. GREAVES-WALKER, N. M. TAYLOR, AND
F. H. NORTON

REPORT OF THE COMMITTEE ON CERAMIC EDUCATION

The past year has been one of the most important in the annals of ceramic education, marking as it did the recognition of ceramic engineering as a curriculum on a par with the older branches of engineering by the Engineers Council for Professional Development and the accrediting of several ceramic engineering departments by that Council. It also marked the recognition of ceramic engineering by the Society for the Promotion of Engineering Education, that body having authorized a Committee on Ceramic Engineering in its Mineral Technology Division at the annual meeting last June.

Upon assuming its duties, the Committee maintained the contact with E.C.P.D. which had been made by H. E. White and his committee the previous year.

Although the accrediting machinery had already been set up and it was too late to make auditing committee changes in all cases, the Committee did succeed in having ceramic and mining engineers appointed to these committees in a majority of cases to replace the originally appointed chemical engineers.

The Committee kept in constant touch with the chairman and other officers and members of the E.C.P.D. during the interval between the visits of the auditing committees to the departments of ceramic engineering and the final meeting of the Council in October, in an effort to convince them that ceramic engineering was not a highly specialized phase of chemical engineering and was worthy of independent recognition.

As is now generally known, ceramic engineering was recognized by the E.C.P.D., and the departments of ceramic engineering at the following institutions are accredited: New York State College of Ceramics (Alfred University), Missouri School of Mines and Metallurgy, Ohio State University, University of Illinois, University of North Carolina, and University of Washington

In June, the Chairman of the Committee attended the annual meeting of the S.P.E.E. in Boston as a representative of the Society and made a successful effort to have that Society recognize ceramic engineering and make a place for it in its organization. A Committee on Ceramic Engineering was organized and given equal rank with mining, metallurgy, geological and petroleum engineering, and fuel technology in the Division of Mineral Technology. A. F. Greaves-Walker was elected vice-chairman of the Division, and J. L. Carruthers and C. M. Dodd were appointed chairman and secretary, respectively, of the Committee on Ceramic Engineering.

During the year, the Committee has also kept in close contact with the American Institute of Mining and Metallurgical Engineers and especially with the members of the Educational Division of that organization. The chairman attended the annual meetings of the Institute in February 1937 and February 1938 as a representative of the Society. The educators in both organizations have many problems in common. The Engineers both in mining and ceramic engineering also have a common problem in persuading State Boards of Engineering Examiners to offer examinations suitable to their particular specialties. At present, in only a few states are any of the engineers in the mineral industries field recognized. Coöperation between the two organizations, especially in educational matters, is therefore highly desirable.

In closing this report, the Committee desires to call the attention of the Society to a condition precipitated by the accrediting program of the E.C.P.D.

In order to be accredited, a curriculum must contain a certain percentage of strictly engineering courses, other than ceramic engineering. Curricula not meeting the requirements are classified as technology. An outside agency has therefore drawn a fairly sharp line between ceramic engineering and ceramic technology.

At its October meeting, the National Council of State Boards of Engineering Examiners adopted the E.C.P.D. accredited list, and graduates of departments not on that list will not be recognized as holding an acceptable engineering degree when applying for a professional license from the various state boards.

With the anticipated completion of the organization of the Institute of Ceramic Engineers at the New Orleans Meeting, the Committee on Education of the Institute will handle all details in connection with ceramic engineering education

This will leave the Committee free during the coming year to devote its time to consideration of ceramic technology education and ceramic art education.

Under the revised Constitution and By-Laws of the Society, H. E. White automatically becomes chairman of the Committee with N. W. Taylor, F. H. Rhead, and E. H. Fritz serving with him, and, in addition, a newly appointed representative of the ceramic educators.

Respectfully submitted,

—A. F. Greaves-Walker, *Chairman;* H. E. White, N. W. Taylor, F. H. Rhead, and E. H. Fritz

REPORT OF COMMITTEE ON STANDARDS

The report of the Committee on Standards of the American Ceramic Society for the year 1937–1938 is made up of the reports of the various representatives of the Society on the several organizations that make up standards and test methods or are otherwise interested in ceramic materials or products.

This report is compiled so that the members of the Society may learn of the work that has been accomplished by these organizations on which the Society is represented.

American Foundrymen's Association (L. C. Hewitt)

The Joint Committee on Foundry Refractories, originally sponsored by the American Foundrymen's Association and the American Ceramic Society, is made up of representatives of a number of associations. These are the Ameri an Ceramic Society, American Foundrymen's Association, American Refractories Institute, Malleable Iron Research Institute, American Society for Testing Materials, Electrochemical Society, National Bureau of Standards, United States Department of Commerce, Division of Simplified Practice, Steel Founders' Society of America, Institute of Metals Division, and American Institute of Mining and Metallurgical Engineers.

Through the officers of the Joint Committee, a number of technical papers has been written and published by the A.F.A. covering the application and use of refractories in the foundry industry.

Standardization as to size of refractories used in malleable furnaces and cupolas has been carried on also, resulting in S.P.R. publications by the Simplified Practice Division of the United States Department of Commerce.

In addition, the A.F.A. generally devotes one session of its annual meetings to papers and discussion of foundry refractories. The A.F.A. is also represented on Committee C-8 of the American Society for Testing Materials.

Committee C-8 on Refractories, American Society for Testing Materials (Nelson W. Taylor)

A new Manual of A.S.T.M. Standards on Refractory

Materials has been published (November, 1937). This covers specifications, methods of testing, definitions, standard samples, analyses of data, industrial surveys, and procedure for calculating heat losses.

The current activities of the Committee are as follows:

(1) Coöperation with the National Bureau of Standards in the development of a method for measuring thermal conductivity at high temperatures.
(2) Development of suitable tests for insulating brick.
(3) Investigation of slagging methods for testing slag resistance of refractories.
(4) Development of better methods for P.C.E. determination: (*a*) by evaluation of testing furnaces and (*b*) possibly by modification of cone series to give equal temperature intervals.

Committee E-1 on Methods of Testing, A.S.T.M. (F. H. NORTON)

The work of Committee E-1 during the year 1937 consisted mainly in evolving satisfactory definitions for the rheological properties of matter. This work has been carried forward under the guidance of E. C. Bingham, and the results are incorporated in the tentative definitions of terms relating to rheological properties of matter, A.S.T.M. Designation E24-37T.

It is felt that these definitions will be helpful in obtaining uniformity in the ceramic literature and will be especially useful to ceramists carrying out work on the plasticity of clays or the viscosity of slips.

Committee C-15 on Manufactured Masonry Units, A.S.T.M. (A. F. GREAVES-WALKER)

Committees C-3 on Brick and C-10 on Hollow Masonry Building Units were merged into Committee C-15 on Manufactured Masonry Units during this year. The subcommittees of the commmittee indicate the scope of the new committee: Clay Building Brick, Concrete, Units, Sand-Lime Brick, Paving Brick, Sewer Brick, Glazed Brick and Tile, and Structural Clay Tile.

Specifications have been formed which include requirements relating to durability and weather resistance of clay-building brick and sand-lime brick. The specifications for paving brick and sewer brick have been revised so that they comply with the new developments in manufacture and use. The tentative specification for glazed brick and tile has been revised. This specification includes methods of testing for glazed brick and tile.

Committee C-14 on Glass and Glass Products, A.S.T.M. (J. C. HOSTETTER)

Committee C-14 has been organized and the subcommittees formed. Undoubtedly this organization will be able to formulate specifications and methods of tests which will be of help to those members of the American Ceramic Society who are interested. Committee C-14 was set up partly as a means of providing a well-recognized and established mechanism for handling many of the international projects with the International Committee on Glass Technology. A report of the activities of this Committee will be made by G. W. Morey during the Fortieth Annual Meeting of the Society.

Committee D-3 on Gaseous Fuels, A.S.T.M. (C. H. PARMELEE)

Each of the Subcommittees, as well as the main Committee, has progressed in its work, and one or more of the subcommittees will have some tentative standards to report to the A.S.T.M. at the spring meeting in 1938.

Committee D-9 on Electrical Insulation Materials, A.S.T.M. (L. E. BARRINGER)

Section A, Porcelain and Other Vitrified Ceramic Products: This Subcommittee has formulated standard methods of testing porcelain, and these are included in A.S.T.M. publications as D-116. At present the Subcommittee is working on methods of test with particular reference to titanium bodies and steatitic materials of interest primarily in the radio field. The methods of test being considered cover mechanical, physical, and electrical properties.

Section B, Glass and Electrical Insulation: This Subcommittee has been studying methods of testing glass with particular reference to mechanical, electrical, and physical properties. To date no standard methods have been formulated, but extensive interlaboratory tests have been under way. The work will be confined, in the future, principally to methods of testing the electrical properties of glass, inasmuch as the study of mechanical and physical properties will be taken up by the recently formed Standing Committee C-14 on Glass and Glass Products. The work of this Standing Committee and that of Section B of Subcommittee V, Committee D-9, will be correlated through representatives who are members of each group.

Petroleum Division, American Society of Mechanical Engineers (H. R. STRAIGHT)

There has been no activity of the Lubrication Committee of this Division during 1937; it is hoped that the Committee will be able to publish a Manual of Industrial Lubrication in the near future.

Process Division, A.S.M.E. (W. K. MCAFEE)

This Division has done nothing in the field of standardization during the past year. Its main purpose is to provide a means of a purely functional approach to problems common to a number of the process industries, which include the ceramic industries. It also serves, through special committees, as a sort of technical society for several small industries that have not developed technical societies of their own.

Committee Z-10, Scientific and Engineering Symbols and Abbreviations, American Standards Association (L. E. BARRINGER)

This Committee consists of a number of subcommittees each one of which has the duty of proposing a list of symbols in its own field. These lists, after being compiled by the Subcommittee, pass through the usual American

Standards Association procedure, and in due course become American standards. A number of lists have already been issued and additional lists are in progress, together with projects for revision of some of the lists already issued. As a part of the general program, a list of principles for use of symbols has been made, which will be prefixed to the lists of all the subcommittees. This clearly distinguishes between symbols to be used in equations which form the main work of the Sectional Committee and abbreviations which are never to be used in equations, but which occur in texts, tables, etc. Symbols for use in equations always consist of a single letter, perhaps followed by subscripts or superscripts.

One of these lists in which the American Ceramic Society is interested is Subcommittee No. 5, Symbols for Heat and Thermodynamics. This Subcommittee has a large number of members, one of whom is R. B. Sosman. The Committee issued an American Tentative Standard, A.S.A. Z10c–1931, which had been generally accepted. During the World Power Conference in the fall of 1936, this Subcommittee arranged an International Conference on Symbols for Heat and Thermodynamics, which was well attended by many interested in these symbols for all nations. A part of the final report of the conclusions of the conference has been issued and the remaining report is well under way. These reports are being discussed by members of Subcommittee No. 5 and by a number of foreign representatives, and it is believed that some compromises may be reached so that a final list will exist which will be in shape for formal adoption by the bodies of a number of nations. The adoption, as far as the United States is concerned, will be the responsibility of Subcommittee No. 5. Dr. Sosman attended the International Conference and continues to represent the point of view of the American Ceramic Society.

International Union of Chemistry (ALEXANDER SILVERMAN)

A report was made on the International Union of Chemistry and published in the *Bulletin of the American Ceramic Society*, **15** [10] 367 (1936). The International Union of Chemistry is a delegate body which meets every two years in a different country in an assembly of representatives chosen by the various governments. In the United States, these representatives are recommended to the National Research Council and the National Academy of Sciences by the various scientific societies. Dr. Silverman has represented the American Ceramic Society at the meetings in Madrid, Spain, in 1934, and in Lucerne, Switzerland, in 1936. He has been recommended as the representative for the 1938 meeting in Rome, Italy.

The International Union, in addition to a general assembly which decides matters of policy, has numerous committees. There are committees on Atomic Weights, Isotopes, Radioactive Constants, Thermochemical Data, Physico-Chemical Symbols, the International Critical Tables, the Reform of Chemical Nomenclature, inorganic, organic, and biological, and the Committee on New Reagents.

Committee C-29 on Insulators for Electric Power Lines, A.S.A. (D. H. ROWLAND)

This Committee was formed in 1935 and had its first meeting in February 1935, at which time it was felt that a complete revision of A.I.E.E. Standard No. 41, which had been adopted previously by the A.S.A. under the C-29-A, should be undertaken with the possibilities of the adoption of characteristics and dimensional standards for the various voltage classes of different types of insulators. A.I.E.E. No. 41 is a test specification describing tests to be made, methods of procedures, and allowable tolerances which had been in existence for some time and adopted by the A.S.A. in 1930. It covered only pin-type and suspension insulators and, since its last revision, impulse testing, time loading tests, impact tests, and many other tests have come into the picture which probably should be covered thoroughly in this specification.

In the 1935 meeting, four subcommittees were appointed, each charged with a specific type of insulator on which to work, that is suspensions, pin types, switch types and guy strain insulators, and spools. The personnel of these committees was appointed by the Chairman at that time, but due to the depression and perhaps also due to the lack of definite assignment, these subcommittees never functioned as such or produced standards of their various types of insulators.

At the meeting held on January 28, 1938, the minutes of the previous meeting were reviewed, and the Chairman requested an expression of the various members present as to whether or not they wished to proceed with the program outlined. Considerable discussion was held during which it was pointed out that the Lightning and Insulator Subcommittee of the A.I.E.E. Committee on Power Transmission and Distribution was anxious to undertake the work of rewriting the testing standard No. 41. This Lightning and Insulator Subcommittee was under the Chairmanship of Philip Sporn, American Gas & Electric Co.; Westinghouse Co.; O. B. Co.; Locke Co.; American Gas & Electric Co.; and the Electric Bond & Share Co.

After considerable discussion it was agreed to turn over the revision of this testing standard to the Lightning and Insulator Subcommittee who were willing and anxious to undertake it. It is the purpose of this Committee to work up a revision of the A.I.E.E. No. 41 covering all of the necessary tests for the testing of all types of power-line insulators, including suspension types, pin types, switch types, strain insulators, spools, and probably bushings. They are not, however, to undertake any work in the preparation of characteristic standards or dimensional standards for insulators of each type in the various voltage classes, this work being reserved for the main Committee in coöperation with N.E.M.A. and E.E.I.

Orton Foundation Board (J. M. MCKINLEY)

The Orton Foundation has been doing a great deal of research work on the improvement of pyrometric cones. They have been making machine-formed cones for use in the A.S.T.M. tests for P.C.E. There has always been considerable complaint about the dimensional inaccuracy of the hand-made cones and the lack of straightness of the cones, both of which were probably due to the hand making of the cones from a stiff-mud body, which caused considerable tendency to warp during drying. It was felt that a semidry-pressed body or at best a plastic-pressed body would be much more uniform and dependable as to di-

THE EDWARD ORTON, JR., CERAMIC FOUNDATION BALANCE SHEET

January 1 to December 31, 1937

ASSETS			
Cash		$ 3,534.82	
Accounts receivable	$ 5,129.01		
Less reserve for bad accounts	313.57	4,815.44	
Savings		1,823.48	
Investment		13,601.43	
Postage		74.34	$ 23,849.51
Raw materials		3,157.56	
Cone powder		5,187.34	
Finished goods		10,948.32	
Packing boxes, labels, etc.		573.41	
Shipping supplies		279.97	20,146.60
Prepaid insurance		295.87	
Prepaid freight		112.46	408.33
Land		22,500.00	
Building	79,870.74		
Less reserve for depreciation	14,072.81	65,797.93	
Machinery and equipment	19,773.92		
Less reserve for depreciation	5,304.34	14,469.58	
Research laboratory	4,011.23		
Less reserve for depreciation	2,270.75	1,740.48	
Office equipment	2,762.66		
Less reserve for depreciation	1,831.80	930.86	105,438.85
Total Assets			$149,843.29
LIABILITIES			
Accounts payable		$ 4,326.50	
Accrued payroll (current)		325.76	
Unemployment insurance reserve		100.46	
Old-age pension reserve		46.48	
California sales tax		26.63	
California postage		0.32	
Accrued mortgage interest		276.83	
Fellowships		1,000.00	$ 6,102.98
Loans Payable			11,100.00
Annuities (Mrs. Orton)			
Certain		13,645.93	
Life		47,766.20	61,412.13
Total Liabilities			78,615.11
NET WORTH ACCOUNTS			
Balance January 1	$50,817.11		
Adj. of Fellowships	215.41	51,032.52	
Net profit to date	23,195.66		
Less profit transferred to Fellowships	3,000.00	20,195.66	
Total Net Worth Account			71,228.18
Total Liabilities and Net Worth Accounts			$149,843.29

mentions and straight drying. They are producing a machine-made, A.S.T.M. cone which is true to prescribed dimensions. It was found necessary to have the cone body of such a consistency so as to flow in the die in order to produce results in cone deformations that are dependable.

The Orton Foundation has had a successful year and is supporting graduate Fellowships at four universities maintaining ceramic departments. In addition to the researches at the ceramic schools, it maintains a research department of its own, which has been working on an iron-free series of cones for use particularly in the structural clay field.

Sectional Committee A-40 on Minimum Requirements for Plumbing and Standardization of Plumbing Equipment, A.S.A. (P. D. HELSER)

When Sectional Committee A-40 was organized, it recognized the following three Subcommittees which had been previously organized at the National Bureau of Standards: (1) *Staple Vitreous China Plumbing Fixtures*, E. S. AITKIN, *Chairman;* (2) *Staple Porcelain (All Clay) Plumbing Equipment*, E. S. AITKIN, *Chairman*, and (3) *Enameled Sanitary Ware*, A. H. CLINE, JR., *Chairman*.

As far as our records show there has been no activity of these subcommittees during the past two years.

Subcommittee No. 8 on Cast-Iron Soil Pipe and Fittings completed its report in 1935, and it was approved and published that same year. The Research Committee on Plumbing, which is in fact a subgroup of Subcommittee No. 1 on Minimum Requirements for Plumbing, has been active recently and held a meeting in New York on January 21. At this meeting, R. B. Hunter, Physicist of the National Bureau of Standards, submitted a comprehensive report of the possibilities of research in the plumbing field and pointed out the importance of dealing with the question of back siphonage and cross-connections in plumbing installations and plumbing fixtures. It is our understanding that the sectional Committee is considering dealing with this question through the activities of the new Subcommittee.

Committee A-41 on Building Code Requirements and Good Practice Recommendations for Masonry, A.S.A. (FREDERICK HEATH, JR.)

Committee A-41 has been completely reorganized during the past year. Originally an autonomous committee, it now has as its sponsor the National Bureau of Standards, and it functions as one of the sectional committees under the supervision of the Building Code Correlating Committee of the American Standards Association.

Recommendations

The Committee on Standards recommends to the President and the Executive Board that application be made to the various organizations for representation of the American Ceramic Society on (1) C-1 on Cement (A.S.T.M.), (2) C-4 on Clay Pipe (A.S.T.M.), (3) C-5 on Fire Tests of Materials and Construction (A.S.T.M.), (4) C-6 on Drain Tile (A.S.T.M.), (5) C-7 on Lime (A.S.T.M.), (6) Technical Committee III of Committee E-1 on Particle Size and Shape (A.S.T.M.), (7) Sectional Committee B-7 on Abrasive Wheels (A.S.A.), (8) Sectional Committee A-1 on Portland Cement (A.S.A.), (9) Sectional Committee A-6 on Drain Tile (A.S.A.), (10) Sectional Committee B-38 on Refrigerator Design (A.S.A.), and (11) Sectional Committee B-44 on Thermometers (A.S.A.).

The scope of these Committees indicates that their work would be of interest to members of the Society, and undoubtedly the membership of our Society could be of assistance to these committees in their work.

The Committee on Standards further recommends that each Division of the Society set up an organization for standards work which can work with the Society's Committee on Standards. This work could be the setting up of definitions, specifications for raw materials or finished products, or methods for testing raw materials or products.

Respectfully submitted,
—JOHN W. WHITTEMORE, *Chairman*,
Committee on Standards

FILM LIBRARY COMMITTEE REPORT FOR 1937

The Film Library Committee, appointed by F. C. Flint in 1936, has published a list of fifty-three films pertaining to the manufacture of ceramic products and their uses. This group was selected from a collection of about one hundred and fifty films. This initial list appeared in the May *Bulletin*, pp. 211–13 (1937). Subsequent films have been published since then, and it is planned to add to this list from time to time as desirable films appear.

From the interest shown and the requests made for these films, it is quite evident that they are popular, and this type of display appears to be growing in popularity and increasing in use.

Members of the Society can help make this list more useful by reporting new films to the Committee.

The Committee wishes to acknowledge the splendid support and coöperation of the office and various members of the Society and companies in collecting this list.

—H. F. SIMPSON, F. B. HOBART, AND R. C. PURDY

ANNUAL REPORTS OF LOCAL SECTIONS

CENTRAL OHIO SECTION

The Central Ohio Section of the American Ceramic Society held five meetings during the past year:

March 12, 1937: C. E. Marshall, University of Missouri; "Constitution of Clay Minerals."

May 10, 1937: W. Weyl, Pennsylvania State College; "Color Problems in Glass."

June 14, 1937: Reception for American Ceramic Society members receiving honors at Ohio State University.

December 22 1937: C. E. MacQuigg, Ohio State Uni-

versity; "Some Impressions of My Trip through Europe."

January 27, 1938: W. H. Atkinson, Owens-Illinois Glass Co.; "Physical and Chemical Characteristics of Fiberglas."

The reception on June 14 was held at the offices of the American Ceramic Society, and a luncheon was served with the compliments of Dr. and Mrs. R. C. Purdy.

The officers of the Section for the year 1937–1938 were as follows:

Chairman: M. C. SHAW *Programs:* J. O. EVERHART
Secretary: T. W. GARVE *Councillor:* J. L. CARRUTHERS

CENTRAL OHIO SECTION

The members of the Central Ohio Section met at the Battelle Memorial Institute, Columbus, Ohio, on January 27, 1938. The speaker for the evening was W. H. Atkinson, Owens-Illinois Glass Co., Newark, Ohio, whose subject was "The Physical and Chemical Characteristics of Fiberglas and Some of Its Commercial Applications."

Mr. Atkinson represents a firm which has been one of the pioneers in the glass industry and his comments concerning this new glass product, known as Fiberglas, were intensely interesting to all of those attending the meeting.

—MYRIL C. SHAW, *Chairman*

CHICAGO SECTION

The officers of the Chicago Section are as follows:

Chairman: A. L. VODICKA, Aetna Porcelain Enameling Co., Chicago
Vice-Chairman: RUDYARD PORTER, Carnegie-Illinois Steel Co., Chicago
Secretary: REXFORD NEWCOMB, JR., Industrial Publications, Inc., Chicago

The Chicago Section had a fairly active season in 1937, particularly due to a number of joint meetings with other groups. The first of these was a joint meeting with the Chicago Branch of the American Chemical Society, January 22, 1937, when C. W. Parmelee, head of the Ceramics Department, University of Illinois, gave an address, "Some Fundamentals of Ceramics," to an overflow crowd at the Stevens Hotel.

On May 13, 14, and 15, a series of lectures by Woldemar Weyl, visiting professor at Pennsylvania State College, was presented at the Annual Conference on Glass Problems at the University of Illinois. This annual feature is sponsored jointly by the Ceramic Department, University of Illinois, and the Chicago Section.

As usual, a majority of Chicago Section members participated in the annual Maypole party of the Chicago enameler's organization. The Annual Golf Tournament was held June 18, 1937, at the Sportsman Club, northwest of Chicago. A small but enthusiastic group turned out for the blind bogey and dinner. Prizes were captured by Bert Sweely, Chicago Vitreous Enamel; G. O. Claeyssens, Chicago Porcelain Enamel, and O. S. Munday, Western Electric.

At the December 18 meeting, Herbert V. Kaeppel of Industrial Publications gave the group his impressions of the various types of ceramic plants on the West Coast. At this meeting, officers were elected for 1938, and the incumbent Board of Advisers to the University of Illinois Board of Trustees was unanimously reëlected on behalf of the Ceramic Department, University of Illinois. The group voted to extend, in conjunction with the Chicago District Enamelers Club, an invitation to the American Ceramic Society to hold the 1939 Annual Meeting in Chicago.

Owing to the somewhat limited ceramic activity in the Chicago area, with the exception of enamels, the Chicago Section will continue to hold joint meetings with other groups and has plans for some meetings in 1938 to educate such outsiders as architects and contractors as to the relative merits of ceramic materials for construction purposes.

—Rexford Newcomb, Jr., *Secretary*

ST. LOUIS SECTION

A dinner meeting of the St. Louis Local Section of the American Ceramic Society was held on January 21, 1938, at 6:30 P.M., at the Little Bevo Restaurant, St. Louis, Mo. Sixty-five persons were present at the meeting, including the following officers: C. M. Dodd, *Chairman;* W. L. Fabianic, *Vice-Chairman;* R. S. Bradley, *Secretary,* and L. A. Kimberling, *Treasurer.*

After the dinner, J. L. Crawford, Chairman of the Nominating Committee, was called on for a report. His committee recommended that the officers who had served for 1937 be reëlected for the ensuing year. The motion was made, seconded, and carried that the recommendation of the Nominating Committee be accepted.

Chairman Dodd mentioned that the parent Society was having a membership drive, and urged everyone present to join the American Ceramic Society.

After the short business meeting, the following papers were presented:

(1) "Research and Engineering Investigations"
By W. R. CHEDSEY, Director, Missouri School of Mines.
(2) "Colloids and the Plasticity of Clays"
By C. J. MONROE, Associate Professor of Physical Chemistry, Missouri School of Mines.
(3) "Spectrographic Mineral Analysis"
By S. R. B. COOKE, Research Metallurgist, Missouri State Mining and Experiment Station.
(4) "Some Progress in the Enameling Industry During the Last Few Years"
By A. I. ANDREWS, Ceramic Engineering Department, University of Illinois.

As a result of a vote taken, it was announced that the next meeting would be held in Rolla, Mo., on May 14. W. M. Weigel, *Chairman,* L. C. Hewitt, and J. L. Crawford were appointed as a committee to prepare a program for this meeting.

—R. S. BRADLEY, *Secretary*

PITTSBURGH SECTION

The Pittsburgh Section met February 8 in the Auditorium of Mellon Institute. R. M. Langley presented the Johns-Manville talking motion picture, "Heat and Its Control." Following the film, A. B. Curtis, Johns-Manville Corp., gave a talk, illustrated by lantern slides, showing methods of calculating the economical amount of insulation and savings resulting from the insulation of various furnaces.

The attendance was unusually large; 140 persons were present, including visiting delegations from the Pittsburgh Section of the American Institute of Chemical Engineers and the Engineering Society of Western Pennsylvania.

Robert B. Sosman, President of the Society, was announced as the speaker at the next meeting of the Section, March 8, 1938.

—C. L. THOMPSON, *Secretary*

SCHOOL NOTES

RUTGERS CERAMICS CLUB

The Rutgers Ceramics Club and Student Branch of the American Ceramic Society resumed its activities in September 1937, with a closed meeting of a business and get-together nature at which the following officers were elected for 1937–1938:

President: GLENN N. HOWATT, 1939; *Vice-President:* OTTO STACH, 1940; *Secretary:* ROBERT R. BROOKS, 1940; *Treasurer:* WILLIAM PESKIN, 1939; and *Councillors:* G. H. BROWN AND J. R. KAUFFMAN.

Plans were outlined for forthcoming meetings and the fact was stressed that through the club meetings the Department of Ceramics at Rutgers University hopes to maintain close relations with the ceramic industries of the State and with the American Ceramic Society.

The feature of the first open meeting on October 11 was a lecture by G. W. Jarman, Jr., Separations Engineering Corp., New York, N. Y. Mr. Jarman spoke on "Removal of Impurities from Ceramic Raw Materials and Bodies," and supplemented his talk with a motion picture pertaining to the same subject.

At the meeting of November 8, G. F. Habekotte, Manager, Insulation Section, Johns-Manville Corp., delivered a talk in connection with the showing of the sound motion picture film, "Heat and Its Control" by courtesy of the Johns-Manville Corporation. The basic concept of this film is the art and science of heat conservation and the story of Man's age-old struggle to control the most powerful force in nature.

On December 13, the Ceramics Club was fortunate in having as guest speaker of the evening E. D. Tillyer, a Rutgers graduate, now affiliated with the American Optical Co., Southbridge, Mass. Dr. Tillyer, who is considered to be an authority on the subject of spectacle lenses and has made important contributions to this field of glass technology (chief among them being the invention of the famous "Tillyer" lenses), spoke on "Ophthalmic Glass and Its Use." His lecture was supplemented with colored slides illustrating progress in this field during the past twenty years, with particular emphasis placed upon the use of radically different compositions in the production of the newer optical glasses now on the market. The meeting was honored by the presence of R. B. Sosman and V. V. Kelsey, President and Vice-President, respectively, of the American Ceramic Society.

A lecture on "Physics and Chemistry of Firing" was the highlight of a meeting of the Rutgers Ceramics Club on January 11. The guest speaker was J. B. Austin, Research Laboratory, United States Steel Corp., who discussed from the chemist's point of view the fundamental changes occurring during the firing and cooling processes in the production of ceramic ware. Slides aided in graphical explanations of the various laws and principles involved.

The meetings of the Rutgers Ceramics Club and Student Branch of the American Ceramic Society are held in the recently refurnished Assembly Room of the Ceramics Building at Rutgers University and are attended by the faculty, student body, graduate students, alumni, and others.

—GILBERT GOODMAN (1941), *Recording Secretary*

Membership in
American Ceramic Society

FOR CONTINUING EDUCATION IN CERAMICS

OHIO STATE UNIVERSITY

The regular monthly meeting of the Student Branch of the American Ceramic Society was held on February 9 in Lord Hall, O. S. U.

A motion picture film on enamels by R. M. King, Dept. of Ceramic Engineering, Ohio State University, was shown. This was followed by a discussion of "The Graduate Engineer in Industry" by Sidney Brooks. The following committees, were appointed: Athletic, Social, Publicity, and Freshman, and a Corresponding Secretary was elected.

Valuable bibliographies, a complete Ceramic Book List, and a Supplement to the Equilibrium Diagrams are in preparation, in addition to the regular monthly publications

MICHAEL JOSEPH OWENS [1]

Michael Joseph Owens, inventor and manufacturer, was born in a coal miner's cabin in Mason County, W. Va., January 1, 1859, son of John and Mary (Chapman) Owens, both natives of Ireland, who came to this country in the early 1840's. When but ten years of age, young Michael was put to work in the glass factory of Hobbs, Brochunier, & Co., Wheeling, W. Va., where he learned the glass-blowers' trade. In 1888, he entered the employ of the Libbey Glass Company at Toledo, Ohio (see biography of Edward Drummond Libbey*), and was soon advanced to manager of the Company's plant in Toledo and of their branch factory at Findlay. He was also given charge of the Company's exhibit at the World's Columbian Exposition at Chicago in 1893. This exhibit was housed in a special building and was equipped at great cost to demonstrate the complete process of making "Libbey" glassware, which came to have a great reputation for quality.

First Invention, Mold Operator

As early as 1891, Mr. Owens directed his attention to the problem of improving on the laborious and physically harmful "hand-and-lung" method of blowing glass which had been followed with little change for two thousand years and which involved the employment of child labor to an extent which was most offensive to the growing public opinion against such factory methods. Guided perhaps by recollections of his own experiences, Mr. Owens invented a "dummy" which took the place of the "mold-boy," who squatted at the feet of the blower to open and close the mold in which the blower finished his ware. This dummy is shown in his first patent, No. 482,526, dated September 13, 1892.

Second Invention, Automatic Bottle Machine

Following this, he worked out a partially automatic machine designed primarily for blowing tumblers which was also found useful in the manufacture of electric light bulbs and lamp chimneys. Mr. Libbey backed him in this venture and its promised success resulted in the incorporation of the Toledo Glass Company on December 17, 1895. Of the 1500 shares of stock in this Company, 375 were issued to Mr. Owens and a like amount to Mr. Libbey for an assignment of the patent rights, and Mr. Libbey subscribed to an additional 250 shares on his own account, thus determining a control of the Company which was maintained to the end. Operating as a development and holding company and never, except incidentally, as a manufacturing concern, the Toledo Glass Company became immensely successful, and its shares eventually rose to more than one hundred times their original value.

Several patents were issued to Owens on this tumbler machine, beginning with No. 524,840 of February 26, 1895. The rights to manufacture tumblers under these patents were sold to the Rochester (Pennsylvania) Tumbler Company. The bulb rights went to the Libbey Glass Company, while the exclusive right to manufacture lamp chimneys was transferred to a subsidiary of the Toledo Glass Company, formed for the purpose, and known as the American Lamp Chimney Company, which was sold out to the Macbeth-Evans Glass Company in 1899.

But while this early machine was measurably successful and is said to be still in use to some extent, it was limited in its field to thin blown (paste mold) ware, and involved the gathering of the glass for each separate article by hand and on a separate blow pipe just as in the old hand practice. It made no impression on the bottle branch of the industry (no bottles were ever made on it), but it met with sufficient approval, financially and otherwise, to encourage the further efforts of Mr. Owens toward mechanizing the glass industry.

Completely Automatic Bottle Machine in 1899

The manufacturing operations of the American Lamp Chimney Company had been in Mr. Owens' charge and its sale to Macbeth-Evans left him free to develop a new idea which was already formulating in his mind, that of a completely automatic bottle blowing machine, based upon the principal of gathering the mold charges by vacuum, *i.e.*, by sucking up the charge into a blank mold, the lower end of which is dipped into a bath of molten glass. His first crude idea in this direction is his so-called "bicycle-pump" shown in patent No. 759,742, filed December 26, 1899, and issued May 10, 1904. This patent shows a hand-pump adapted to be associated with a blank and blow mold, the stroke of the pump in one direction being utilized to draw the glass into the blank mold, while the stroke of the pump in the other direction caused the blank to be expanded to bottle form in the blow mold. Crude as this device was, it embodied the germ of an inventive concept which was to revolutionize the bottle industry and which still, after more than thirty years, accounts for the greater part of the commercial bottles produced today.

A practical bottle machine, however, was still a long way in the future. On Mr. Owens' recommendation, the Toledo Glass Company engaged W. E. Bock as engineer to design and construct a machine under Mr. Owens' direction and to carry out his proposed suction method. Several experimental machines were built, each an improvement on the other, but it was nearly six years before commercial returns were realized. Owens patent No. 766,768, filed April 13, 1903, and issued August 2, 1904, discloses most of the essentials of his final machine, but this design did not satisfy Mr. Owens because of the intermittent or start-and-stop character of its rotary movement which had been built into the machine during his serious illness. He immediately insisted on its being redesigned for continuous rotation, with the result that the so-called A-type of machine was next completed and found satisfactory for commercial use. Bock patent No. 870,664, filed May 2, 1905, and issued

[1] Revised biographical sketch of Michael Joseph Owens, based on proofs submitted by the National Cyclopedia of American Biography under date of June 3, 1936.

* *Bull. Amer. Ceram. Soc.*, **17** [2] 81 (1938).

November 12, 1907, shows this A machine which also embodied the revolving pot shown in the Owens patent No. 774,690, filed December 22, 1903, and issued November 8, 1904.

The method followed in this and subsequent Owens machines consists first in gathering an embryo bottle, called a "blank" or "parison," in the blank mold, formed of superposed parts (a body blank portion and a neck portion, both made in separable halves) and arranged to be exhausted by a vacuum connection which is turned on simultaneously with the dipping of the mold into a revolving pot of hot glass that is continuously fed from a melting furnace. The resultant suction draws the glass almost instantaneously into the mold cavity to form a blank of exact shape and dimensions. The upper end of the blank (within the neck mold) immediately takes its final exterior shape. The lower end of the blank is cut off from its connection with the body of glass in the bank by a knife which swings across the bottom of the blank mold as soon as the latter is lifted out of the glass. The body portion of this mold is then opened or stripped away leaving the blank suspended by the neck mold, which still remains closed, and immediately afterward the final finishing or "blow" mold rises into position around the suspended blank and is closed about it. In the meantime, a center cavity will have been initially formed in the neck of the blank by a pin or plunger which, being lifted out of the way, permits blowing air under considerable pressure to be forced down through the neck and into the body of the blank.

The neck being still held tightly within the neck mold is unable to expand and keeps its original dimensions, but the body of the blank, now hanging freely within the larger cavity of the blow mold, spreads out like a bubble until it takes the shape of the cavity, which is made of the size and proportions of the bottle desired.

All this takes place as each set of molds (consisting of the neck mold, body blank mold, and blow mold) travels in a circular path about the central supporting column of the machine, and the blowing continues until the molds again approach the revolving pot. Just before the pot is reached, the neck molds are opened so as to release the neck of the newly blown bottle, leaving its body still held within the blow mold, which now swings down so that it passes beneath the revolving pot and clear of the latter. Meanwhile the body- and neck-mold sections of the blank mold are again brought together in closed position and again travel over the pot to dip into the hot glass and suck up another charge as before. The blow-mold sections open to release the newly formed bottle while in their lowered position, just after they emerge from beneath the pot, and being now empty are again raised to embrace the newly gathered parison and the operation is repeated.

Each such set of molds is mounted in a separate framework called a "head" or "arm," and really operates as an independent bottle-blowing machine. In the original or A-type of Owens machine, six such arms were mounted about a supporting central column so that, with molds having but a single cavity, six bottles would be made with each revolution of the machine. Later on machines of eight, ten, fifteen, and even twenty heads were developed, and multiple cavities in the mold were provided, thus enormously increasing the number of bottles which could be produced in a given time. A thousand gross of beer bottles (nominal pints), each twenty-four hours, is well within the capacity of the larger of these machines working with double-cavity molds. Smaller bottles, made in triple or even quadruple cavity molds, can be produced in correspondingly larger quantities.

Leer Designed in 1909

The annealing of bottles, when produced in such great quantities, raised new problems which Mr. Owens solved by an entirely original type of leer shown in his patent No. 1,117,433, dated November 17, 1914, the application for which was filed January 18, 1909. The long narrow pans of this leer were provided with separate cavities into which the bottles were dropped upside down as they were discharged from the blow molds of the bottle machine. Being fully loaded with bottles, each pan in succession was then made to travel slowly through a long heated tunnel or oven in which the annealing action took place, and being unloaded by operatives stationed at the far end of the leer, the pans were returned mechanically to the front of the leer to receive another load of bottles as before.

The entire operation thus became automatic, there being no intervention of human hands from the feeding of the sand, lime, and other glassmaking ingredients into the melting furnace at one end of the factory to the taking out of the finished and annealed bottles at the other end of the factory, some two or three hundred feet away. And not only were bottles thus produced automatically and in quantities never before dreamed of, but the precision of the operation was such that for the first time exact duplication in shape, size, and capacity could be relied upon, an exactness which the most skillful of hand blowers had never been able to more than roughly approximate.

Such was the miracle of the Owens automatic bottle machine, which entirely revolutionized the bottle blowing industry, and did more to do away with child labor in glass plants than all legislative and philanthropic efforts combined.

Owens Bottle Company Organized

By the fall of 1903, the promise of its success was considered sufficient to warrant the incorporation of the Owens Bottle Machine Company, which took from the Toledo Glass Company an exclusive license for the United States under all related Toledo Glass patents, with the right to grant sublicenses. At this time it was contemplated that the business of the Company would be confined to building these machines and placing them under license with such independent bottle manufacturing concerns as would wish to adopt them. Hence the inclusion of the word "Machine" in the name of the Company. Later on, at Mr. Owens' insistence, this policy was abandoned, and the Owens Bottle Machine Company itself began to manufacture bottles, eventually dropping the word "Machine" from its title and becoming, by the time of Mr. Owens' death, the largest manufacturer of bottles in the world.

Licenses Granted to Bottle Companies

The Owens Bottle Company issued its first license September 13, 1904, to a newly organized concern called the Northwestern Ohio Bottle Company. This Company was taken over by the Ohio Bottle Company, subsequently

known as the American Bottle Company, with plants at Newark, Ohio, and Streator, Ill., which assumed the license and on August 31, 1905, paid the first royalty returns to the Owens Bottle Machine Company, in the amount of $1337.58. Within a year after that, by September, 1906, this concern had fifteen of the Owens machines in operation. In July, 1905, a license to make milk bottles was issued to the Baldwin-Travis Company of Kane, Pa., later absorbed by the Thatcher Manufacturing Company of Elmira, N. Y., and from this point on the placing of Owens bottle machines proceeded very rapidly. Licenses for the manufacture of various types of bottles were, during the next few years, extended to the Hazel-Atlas Glass Company of Wheeling, W. Va., the Illinois Glass Company of Alton, Ill., Ball Brothers of Muncie, Ind. (fruit jars), the Charles Boldt Glass Company of Cincinnati, Ohio, and the Maryland Glass Company of Baltimore, Md. The rights for Canada were sold by the Toledo Glass Company to the Dominion Glass Company, Ltd., of Montreal.

Had to Show Europeans by Building a Plant

In 1907, the foreign rights were sold to a European syndicate having its headquarters at Düsseldorf and known as Europaischer Verband der Flaschenfabriken, G.m.b.H. Being strongly wedded to hand operations, European manufacturers were slower to recognize the advantages of machine production, and it was not until the Owens European Bottle Machine Company, organized in 1905 to handle foreign rights, had built a factory in Manchester, England, and demonstrated the superiority of the Owens method of manufacture, that this sale was accomplished. The sale price was 15 million marks, the equivalent of about $3,000,000.

Bottle Machine Further Developed

In 1911 to 1912, Mr. Owens brought out his ten-arm "AN" and "AR" type machines with the assistance of Richard La France, a young designer whom he had promoted to chief engineer upon the resignation of Mr. Bock in 1910. These ten-arm machines became the Owens standard and have so remained ever since, although a number of fifteen-arm machines (known as the "AV" and "AQ") were built and put into use shortly afterward and are still preferred for certain situations.

Carboy Machine

Mr. Owens also directed the building of a special machine for blowing the largest sizes of bottles or "carboys" of a capacity up to fourteen gallons. This machine was subsequently installed in the Alton plant of the Illinois Glass Company, where it is still in use. Only one such machine was ever built, because its productive capacity when operated less than half the time is such as to supply the entire demand (about 300,000 per year) for these large containers. This carboy machine (known as the "AT") is disclosed in Owens patent No. 1,322,726 filed October 26, 1914, and issued November 25, 1919.

Window Glass Machine

The years 1912 to 1918 saw the successful development, under Mr. Owens' direction, of a revolutionary process of producing window glass, which was invented by Irving W. Colburn, who had already spent five years and several hundred thousand dollars on his efforts. He was quite at the end of his resources when Mr. Owens visited his plant at Franklin, Pa., and recognized the possibilities involved.

Up to this time, window glass had always been produced by blowing a bubble of glass, usually in the form of a cylinder, that was subsequently split and flattened in a hot oven. Necessarily it was a discontinuous process, and it was inherently defective in that the greater circumference of the outer surface of the cylinder caused a slight buckling of the glass when flattened and marred the perfection of the sheet. American inventors had been successful in mechanizing this cylinder process which, up to the beginning of this century, had always been carried on in hand factories, but the inherent defects of the process noted above still obtained.

Colburn visualized the continuous production of an initially flat sheet of glass, from the advancing front edge of which individual pieces could be cut off endlessly in whatever sizes were needed, and this dream was realized under Mr. Owens' management before Colburn's death in 1917. Through Owens' influence with Mr. Libbey, the Toledo Glass Company bid in the patents of the bankrupt Colburn Machine Glass Company when sold at public auction at Pittsburgh, February 8, 1912, and Colburn was brought to Toledo and given the advantages of a new plant and ample financial backing. It took several more years and a million of dollars to achieve commercial results, but by the spring of 1916 success was sufficiently in sight to warrant the incorporation of the Libbey-Owens Sheet Glass Company to take over this development.

Libbey-Owens-Ford Company

Mr. Libbey was made president and Mr. Owens the vice-president and general manager of this organization, which speedily took its place as one of the world's largest producers of window glass. Later it was combined with the Edward Ford Plate Glass Company as the Libbey-Owens-Ford Company, the standing of which in the flat glass industry is world wide.

Mr. Owens' last inventive activity was his "CA" machine, the first of which was being successfully tried out during the very month that he died. This was a huge twenty-arm bottle-blowing machine, the fundamentals of which are shown in his patent No. 1,547,439, applied for August 11, 1921, but which did not issue until July 28, 1925, following his death. His final patent, No. 1,600,484, filed by his administrators September 20, 1924, and issued September 21, 1926, related to a glassmelting furnace suitable for this "CA" machine. Mechanically this machine, which weighed some eighty or more tons, proved satisfactory, but there turned out to be few bottle orders calling for quantities large enough to warrant the investment, with the result that this size and type of machine has since been abandoned in favor of lighter and more flexible units.

Mr. Owens Passed Away in 1923

Mr. Owens died suddenly December 27, 1923, while attending a meeting of the board of directors of the Owens Bottle Company, his activity thus continuing to the end. A devout Roman Catholic, his last words were "Send for Father Dean." Mr. Libbey died within two years, November 13, 1925.

The long and intimate association of E. D. Libbey and M. J. Owens, from which had sprung not merely one but two of the most revolutionary and successful industrial developments of recent times, naturally leads to personal comparisons. They were a great team, each complementary of the other. Owens was the dynamic force and originator. Libbey furnished the financial and organizing genius. Careless of money and generous to a fault, "M. J.," although a rich man by most standards, achieved but a fraction of the fortune which E. D. Libbey, equally generous by nature, almost automatically accumulated and devoted to the best public needs.

Of the two, Owens was the more dominant character, a natural born leader, subservient to none. Strong physically, he was a fighter by instinct, and in his earlier days often enforced his orders with his fists. Almost without schooling, he gave the impression of great mental vigor and quickness of thought. Had he been so trained, he would have made a great lawyer. If his early ambitions had received a political direction, he might well have been a great "boss." With a leonine head set on broad shoulders and most impressive appearance, he looked, as someone has said, the way a United States senator ought to look. He was, unquestionably, the foremost figure of his day in the glass industry of the world As such he left no successor.

EDWARD ORTON, JR., IN THE IRON INDUSTRY

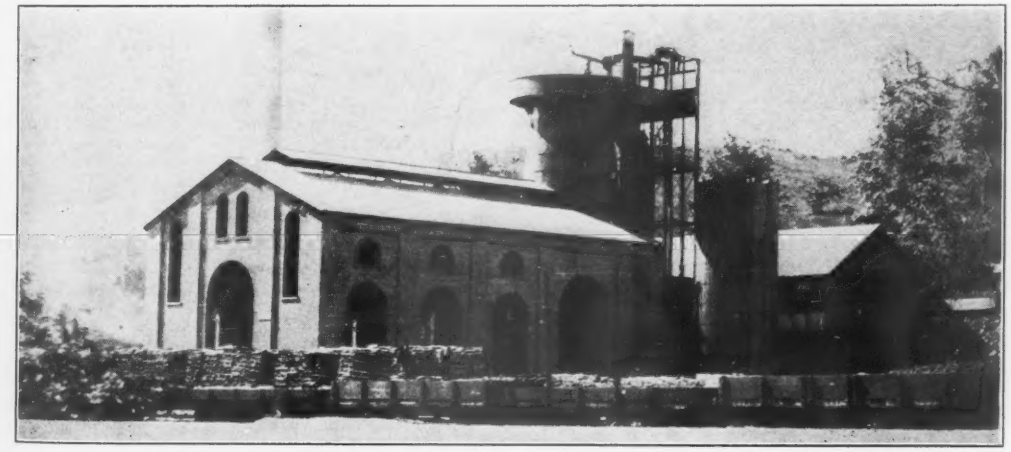
By Wilber Stout

On March 1, 1883, Winona, Craft's, Union, Lee, Floodwood, Helen, and Gore furnaces in the Hocking Valley field pooled their interests and were consolidated into the Columbus and Hocking Coal and Iron Company with Samuel Thomas, president; John R. Buchtel, Walter Craft, and T. Longstreth, vice-presidents; S. Churchill, treasurer; H. D. Turney, secretary; H. F. Holloway, assistant secretary; and E. B. Green, superintendent and general manager. This organization held thousands of acres of mineral land in Athens, Hocking, and Perry counties, produced merchant iron in a large way in six furnaces and marketed coal for the general trade from the great Middle Kittanning member. Although the firm was progressive and ably managed by experienced men, they also sought others schooled more technically in the fields of metallurgy, chemistry, and mine engineering. To this end they added several young men, fresh from college, among whom was Edward Orton, Jr.

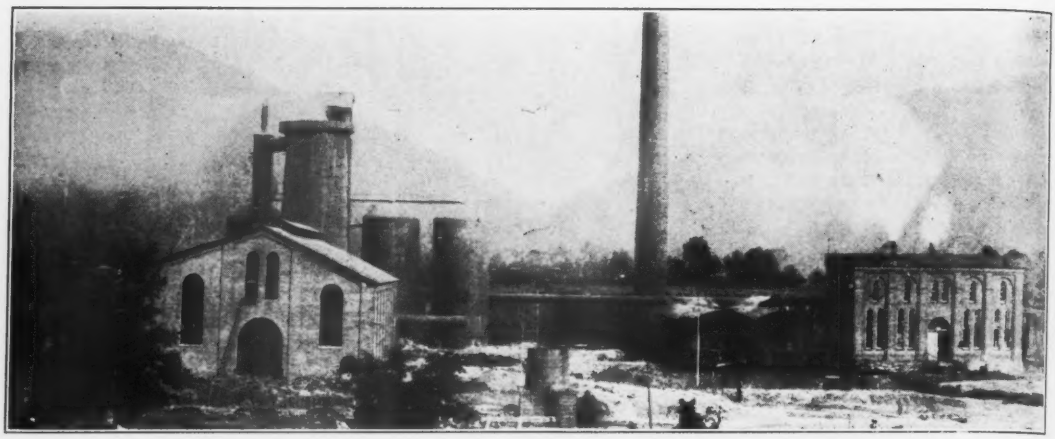
Young Orton, just after graduation in June, 1884, as an Engineer of Mines, was brought into the district for various services. His prescribed duties were chemistry and mine surveying, and his first headquarters were at the Buchtel furnaces just south of Nelsonville. For the first few years, his time was taken up with work in the mines.

Bessie furnace, located about one mile west of New Straitsville in Perry County, Ohio, was promoted by Moss and Marshall and was one of the outstanding stacks in the group of sixteen furnaces then or soon after placed in blast in the Hocking Valley district. Erection of Bessie furnace began April 15, 1877, and was so pushed that it was placed in blast January 21, 1878. This stack was 50 feet in height, 14 feet in diameter at the boshes, 6 feet in diameter in the hearth, and had a capacity of 25 tons per day. It was first operated on iron ores, Maxville limestone, and Middle Kittanning coal, all gathered in the hills nearby.

On account of his high efficiency, Orton was promoted in 1888 to the superintendency of Bessie furnace, where he was well acquainted both with the stock for smelting and the workings of the furnace. He immediately began smelting ferro-silicon iron, the first to be regularly produced in a commercial way in the United States. Root



Original Bessie furnace as managed by Edward Orton, Jr. (photo from John Eberts, Columbus, Ohio).



Victoria furnace, Goshen Bridge, Va.; furnace blown by Edward Orton, Jr., in 1889; leased at that time to Columbus and Hocking Coal and Iron Co. (picture was taken in 1889). Orton was there only a short time, from February to July, 1889. The furnace is 85 feet high and the chimney 244 feet high; three Hemphill-McIntosh engines, cog gear (photo from W. E. Buchanan, Columbus, Ohio).

Men working for Orton at Victoria furnace, Goshen Bridge, Va., in 1889. *Left to right:* Theodore Hedge, general yard boss (on steps); W. E. Buchanan, ran dinky for hauling cinder away from furnace; Thomas Whalen, keeper; George Kiser, stockhouse boss; Arthur Manning, second engineer; William Crawford, turn foreman; Jackson Gooch, first engineer; John Beck, turn foreman; John Root, stove tender; James Johnson, in office; Bowman, carpenter; John Hardington, blacksmith; John Covan, master mechanic; John Winefortner, stove tender. Hedge, Buchanan, Whalen, and Winefortner went with Orton from Bessie to Victoria furnace; John Covan helped Orton set up his first ceramic department in Orton Hall, Ohio State University (photo from W. E. Buchanan, Columbus, Ohio).

states, "Orton's task at Bessie was not an ordinary superintendent's job. It was an attempt to make 10 to 12% ferro-silicon pig iron as a regular product of the furnace. Previous to this, the furnace had been making silvery iron with a content of 6 to 8% silicon from iron ores from Vinton County. Originally the furnace made foundry grades of iron from the carbonate ores of the immediate vicinity."

Soon after becoming superintendent of Bessie furnace, Orton set up a small laboratory there where he did some work for furnace control. He thus became the first chemist in the Hocking Valley district and one of a few then qualifying in this capacity in the State. True the chemical work was not extensive, being confined mainly to the routine running of silicon and occasionally to determining sulfur, phosphorous, and manganese in the pig metal and iron, lime, and magnesia in the ore burden.

Orton was well liked as a superintendent. Chris Eberts, who worked under him there, says, "He was very strong and rugged and always busy. He never asked a man to do something that he would not do himself, such as the dirty job of cleaning stoves, the hot task of keeping the furnace, or the laborious work of carrying the iron out of the sand.

He did many tasks, such as laying brick in patchwork on stoves and boilers, putting in tuyères and bosh plates, and carpentering or blacksmithing if the occasion required."

While at Bessie furnace, Edward Orton, Jr., was married on October 28, 1888, to Miss Mary Princess Anderson of Columbus. The Ortons lived at Bessie furnace in a dwelling next to the store and kept a little black dog as a pet. When they moved from Bessie to Victoria furnace, Virginia, the carpenter crated his household goods for shipment.

In 1889, the Columbus and Hocking Coal and Iron Company leased the Victoria furnace at Goshen Bridge, Rock Bridge County, Virginia, and made Orton manager. He took charge February 1, 1889. This was one of the most modern furnaces in the United States at that time. It was 85 feet in height, steel jacketed, and charged from a platform at the top of the furnace. The accessory equipment consisted of three Whitwell stoves, cast and engine houses of brick, three Hemphill-McIntosh engines for blast, a dinky engine for yard transportation, and railroad connections to bring in supplies and ship out pig metal and slag. The ores contained some zinc which led to early failure of the linings. Orton took from Bessie furnace Theodore Hedge, general yard boss; W. E. Buchanan, engineer on the dinky engine; Monroe Walter, store clerk; Bony Wilson, yard foreman; Thomas Whalen, furnace keeper; and John Winefortner, stove tender.

Orton was at the Victoria furnace only a short time, from February to July, 1889, but while there he had considerable trouble owing to the damage of the zinc oxide volatilizing out of the ores into the brickwork, thus causing early failure. He had only a few months service out of the first lining.

Root states, "Following his work at Victoria furnace he went to Homestead, Pennsylvania, in July 1889, and engaged in an effort to learn the open-hearth steel process in a practical way with the Homestead works of the Carnegie Steel Company. He progressed to a point where he was ready to take charge of a furnace as a heater. He then left Homestead in 1892, came to Columbus, and was engaged by Mr. Hallwood of the Hallwood Block and Paving Brick Company as ceramic engineer. Orton pursued the iron and steel industry with much energy, with patience to detail, and with scientific application."

References

Personal notes given by Chris and John Eberts Columbus, Ohio. Personal data from W. E. Buchanan, Columbus, Ohio. Personal data from Willis Jay Root, St. Petersburg, Fla. Historical data on Bessie furnace gathered from several sources: (*a*) Directory to Iron and Steel Works of the United States, American Iron and Steel Assn., 1878 to 1920; (*b*) Field note book, John J. Dun, 1882; (*c*) Geological Survey of Ohio, Vol. V, 1884; and (*d*) Bureau of Labor Statistics, 1877.

NOTES AND NEWS

EDWARD ORTON, JR., COMMEMORATION

A program, presenting the career and achievements of Edward Orton, Jr., on the sixth anniversary of his death, was given in the Grand Lounge of the Faculty Club of Ohio State University on Thursday evening, February 10, 1938.

Arthur S. Watts, Chairman of the Department of Ceramic Engineering, Ohio State University, presided, and the following program was presented:

(1) LIFE OF EDWARD ORTON, JR.
A series of lantern slides with comments by his sister, Mrs. F. C. Caldwell.

(2) EDWARD ORTON, JR., THE ENGINEER
By F. A. Ray, Professor Emeritus of Mine Engineering, Ohio State University

(3) EDWARD ORTON, JR., IN THE IRON INDUSTRY
By Wilber Stout, State Geologist of Ohio.

(4) EDWARD ORTON, JR., THE GEOLOGIST
By George A. Bole, Manager, Edward Orton, Jr., Ceramic Foundation

(5) EDWARD ORTON, JR., THE CERAMIST
By A. V. Bleininger, Homer Laughlin China Co., Newell, W. Va.

(6) EDWARD ORTON, JR., THE EDUCATOR
By E. A. Hitchcock, Dean Emeritus, College of Engineering, Ohio State University.

(7) EDWARD ORTON, JR., THE SOLDIER
By Col. W. M. Mumm, U. S. Army Reserve, Retired.

(8) EDWARD ORTON, JR., THE CITIZEN
By James A. Maddox, Columbus Chamber of Commerce.

CANADIAN CERAMIC SOCIETY ANNUAL MEETING

The Canadian Ceramic Society, Gordon C. Keith, *Secretary*, held its Thirty-Sixth Annual Meeting at the General Brock Hotel, Niagara Falls, Ontario, February 8 and 9, 1938. A General Sessions Program was held on Monday and separate sessions of the Clay and Enamel Divisions were scheduled for Tuesday.

Following the banquet on Monday evening, Life Memberships in the Canadian Ceramic Society were presented to Ross C. Purdy, Secretary of the American Ceramic Society, and to General C. H. Mitchell, Dean of the Faculty of Applied Science, University of Toronto. These certificates were presented by George Emery of Hamilton, Ontario, and by William Chester Smith of the University of Toronto. Life Memberships were also sent to J. W. Mellor, Secretary, The Ceramic Society, Stoke-on-Trent, England, and William Burgess, a charter member of the Candian Ceramic Society. Dr. Mellor and Mr. Burgess were not able to attend the meeting.

INTERNATIONAL CONGRESS ON TECHNICAL EDUCATION

The next International Congress on Technical Education is to be held in Berlin, Germany, from July 25 to 29, 1938. The Secretary of the Bureau International de l'Enseignement Technique is located at 2 Place de la Bourse, Paris, France.

PRESIDENT SOSMANS CLASSMATES AT M.I.T.

Members of the Research Laboratory of Physical Chemistry, Massachusetts Institute of Technology, Trinity Place, Boston, Massachusetts, in 1906.

Standing, left to right:
R. D. MAILEY (Vice-President, General Electric Vapor Lamp Co., Hoboken, N. J.)
CHARLES FIELD
G. A. ABBOTT (Prof. Chemistry, University of North Dakota)
R. C. TOLMAN (Prof. Physics, California Institute of Technology)
C. A. KRAUS (Prof. Chemistry, Brown University, President-Elect, American Chemical Society)
C. W. KANOLT (Perser Co., New York, N. Y.)
W. C. BRAY (Prof. Chemistry, University of California)
G. W. EASTMAN (deceased)
M. A. STEWART (U. S. Patent Office)
R. B. SOSMAN (President, American Ceramic Society)
E. W. WASHBURN (Third Editor, *Journal American Ceramic Society*, deceased)

Seated:
G. N. LEWIS (Prof. Chemistry, University of California)
M. S. SHERRILL (Prof. Chemistry, Massachusetts Institute of Technology)
A. A. NOYES (Director of the Laboratory, deceased)
H. M. GOODWIN (Dean of Graduate School, Massachusetts Institute of Technology)
A. C. MELCHER (Purchasing Agent, Massachusetts Institute of Technology)
R. HASKELL (Research Engineer, Texas Oil Co.)

CENTRAL DISTRICT ENAMELERS' CLUB

The first meeting for 1938 of the Central District Enamelers' Club was held on February 3 at Guild Hall, Builders' Exchange Building, Cleveland, Ohio. After the dinner, the following program was presented: J. C. Eckels, Assistant Manager, Sales Sheet Division, Carnegie-Illinois Steel Corp., spoke on "An Untold Opportunity," and J. H. Crowe, Chief Metallurgist, Republic Steel Corp., Massillon, Ohio, discussed "The Enamel Industry as Related to Iron and Steel."

The new film produced by the American Rolling Mill Company on "The Romance of Iron and Steel" was also shown. This colorful story of the manufacture of sheet iron and steel, from iron ore to finished products for the home, industry, commerce, and agriculture, is told in a sound film.

The officers of this organization are as follows: R. D. Landrum, Harshaw Chemical Co.; R. S. Cobb, Moore Enameling & Mfg. Co.; G. B. Fulton, Alliance Porcelain Products Co; A. W. Leesburg, American Stove Co.; J. B. Simonds, Westinghouse Electric & Mfg. Co.; R. H. Schwendler, Enamel Products Co.; and L. W. Brashares, American Rolling Mill Co.

MANUAL OF PORCELAIN ENAMELING

New Book Edited by J. E. Hansen

The book, A Manual of Porcelain Enameling, edited by J. E. Hansen and published by the Enamelist Publishing Company of Cleveland, Ohio, is a valuable contribution to the technique and practice of porcelain enameling. It is more than a revision of the former issues, The Technique of Vitreous Enameling, and The Advanced Technique of Porcelain Enameling, published in 1927 and 1932, respectively. This is an entirely new book. The twenty-three chapters were written by different members of the Ferro Enamel Corporation, each taking the subject or subjects with which he is most familiar.

R. A. Weaver gives an excellent review of the history of enameling, following its development from an art, through its early growth, to its present industrial importance. He mentions some of the more recent developments and predicts an increasing growth for the enameling industry in the future.

L. B. Hart discusses the design and fabrication of sheet-iron parts. This is handled very well with illustrations of many of the factors of good design. He also takes up the

subjects of selecting the metal stock, shearing, blanking, forming, assembling, welding, metal finishing, and repairs.

R. B. Schaal, in the chapter entitled "Cast Iron for Enameling Purposes," discusses the chemical and metallographic compositions, giving photomicrographs to illustrate the characteristics of cast iron used for different purposes. Foundry operations are described, and the metallurgy is discussed from the standpoint of producing good castings for enameling.

A. H. Haessler in "Preparation of Metal Surfaces," brings the information from Advanced Technique of Porcelain Enameling up to date. He has supplemented this material considerably, adding such operations as centrifugal methods of blasting, use of the filter press, sulfide pickling, and cyanide neutralizing.

J. E. Hansen, in "Enamel Mill Room Practice," supplements the similar chapter in his former book.

M. J. Bahnsen gives a good discussion of mill additions, taking up the questions of different clays, set-up agents, opacifiers, and colors with the different kinds of enamels. He discusses the setting-up agents for different kinds of slips, such as ground coats and enamels of the acid-resisting, cast-iron, and hollow-ware types. The different kinds of opacifiers and the compounding of mill batches of white and colors are discussed in detail.

J. T. Irwin gives an interesting discussion of natural waters, their characteristics in different parts of the U. S., and their effects on cleaner, rinse, pickle, and neutralizing solutions. In the use of mill water, he goes further into the subject of composition and gives a table of typical analyses of public waters in the more important cities of the country. Methods for water analysis are given.

In discussing the compressed-air supply, he emphasizes proper pressure, capacity, and freedom from foreign material. The equipment, such as the compressors, intercoolers, aftercoolers, air receivers, separators, and pipe lines, are described and discussed.

In the chapter on the "Application of Enamel," G. S. Lindsey appropriately begins with methods for bringing the slip to the proper condition for application. He then describes the different methods of application, including technique and automatic equipment, and explains the care of spray guns, pressure tanks, and continuous equipment.

R. R. Sherrill gives the fundamental principles of drying as applied to enamels and a description of conveyer and room-type driers. He divides heating methods into two classes, radiation and convection, and describes how they are applied to the drier. The defects caused by drying conditions are given.

Special operations are taken up in separate chapters, viz., "Brushing," by C. D. Parkhill; "The Enameling of Signs," by H. C. Beasley; and "Enameling of Hollow-ware," by G. H. McIntyre. The reasons for brushing, equipment, operations, defects arising from brushing, and the removal of dust are explained. The sign enamels and their application, drying, brushing, firing, and inspection are discussed together with the use of the screen process. Kitchenware enamels are classified as mottled gray finishes, two-coat ware, and triple-coat ware. The selection of the stock and the forming, special phases of the preparation of the iron surface, preparation of the enamel, and the set are discussed. The different operations, such as dipping, beading, stippling, drying, firing, and inspection, are described, and the methods of testing and properties of the product are given.

H. A. Connor takes up the firing or "burning" operation from the standpoint both of wet-process cast-iron and sheet-iron enamels. Defects, firing time and temperature, loading, sulfur scum, maintenance, and continuous furnace operation are discussed.

J. E. Hansen gives sample inspector's report sheets and points out the methods and places in operation where inspection is important. He discusses decorating effects, such as graining, marbleizing, screen process, decalcomanias, and printing. The methods used and the types of equipment are described.

In the revised chapter on shop troubles, L. B. Hart discusses troubles caused by the stock, preparation of the metal, enamel application, and firing. Such defects as blistering, boiling, fishscaling, jumping, popping, scale, hairlines, crazing, copperheads, chipping, tearing, rusting, pinmarks or stars, warpage, orange peel, shorelines, and sagging are described and their causes stated.

In the chapter on "Process Control Methods," W. N. Noble gives not only the methods but also the specifications. He describes the control of the slip, the pickle room, application, and firing. Tests, such as impact, thickness, hardness, and acid resistance, are also described.

The chapter on "Enamel Furnaces and Refractory Development," by F. S. Markert, describes the changes taking place in furnace development from the first crude box-type furnace to the modern continuous types. The part played by the development of refractories and furnace alloys is indicated.

Furnace atmosphere and temperature gradient are discussed by G. H. McIntyre, who outlines the importance of and gives directions for determining the composition of the atmosphere and the temperature. Data are shown to illustrate the ordinary existing conditions.

J. T. Irwin gives a brief introduction to the subject of "Fuels and the Principles of Combustion." He describes the different kinds of fuels, gives a comparison of them and their methods of use, and discusses the methods of storage, the equipment used for handling, and control.

In the chapter on "Enamel Shop Construction, Equipment, and Layout," E. W. Dany emphasizes lighting, ventilation, and safety. The equipment used for a one-furnace shop is listed. The layout, passage-ways, conveyers, and the arrangement of different operations to obtain greatest efficiency are discussed.

Under the title of "Enamel Plant Management," D. L. Cable takes up the questions of plant location, factory buildings, personnel organization and training, payment plans, supervision, production organization, operating capacity, schedule planning, scrap replacement, handling equipment, technical operations, maintenance, and financial control.

In addition to the book proper, there is an appendix of useful tables and a dictionary of enamel terms, the latter compiled by Kenneth Hossack. A generous bibliography follows each chapter.

—A. I. ANDREWS

IOWA STATE COLLEGE BULLETIN ON POTTERY

January 19, 1938

You may be interested in the results of my little elementary pottery *Bulletin*, No. 133. The first edition of 3000 went out in two months. A second edition of 5000 is down to 1700 remaining copies, and some Government outfit called for 1500 copies the other day. I am not informed as how a third printing will be handled but I surmise that a charge will be made hereafter for more than one copy.

This means that more than 8000 persons in the United States are interested in ceramics as a hobby.

I get about three applications a week now for the *Bulletin* and the Station piles up applications which I see at the end of each month. Africa, India, Norway, and England as well as island possessions of this country are using the *Bulletin* in education in pottery making.

This is the *first bulletin ever reprinted here.*

—PAUL E. COX, *Department of Ceramic Engineering*

NATIONAL PAVING BRICK ASSOCIATION OFFICERS ELECTED

The Board of Governors of the National Paving Brick Association held its Annual Meeting on January 12, 1938, during the Thirty-Second Annual Meeting. It organized for the year by selecting H. C. Gardner of the Illinois Region, Chairman of the Board, after which the officers of the National Association were elected. C. C. Blair of the Ohio Region, who had been made President to fill the unexpired term of the late O. W. Renkert at a meeting held in French Lick in November, was unanimously re-elected to head the Association for next year. W. H. Moseley of the Illinois Region was elected Vice-President, S. Nirdlinger, Treasurer, and G. F. Schlesinger, Engineer-Director, Secretary.

RESEARCH LABORATORIES*

By A. E. WHITE†

There are over 1600 industrial research laboratories in the United States. This number does not include federal, state, or municipal government laboratories or the 186 college laboratories which are conducted not only for instructional purposes but also, to a considerable extent, for research work. This number is astounding. It shows the widespread interest in research and the extent to which industry depends upon the findings of these laboratories for the improvement in their existing products and the development of new products.

Many of these industrial research laboratories are small, although of prime importance to the companies they serve. Others are large; one employs approximately 3000 research physicists, chemists, and engineers, and others immediately concerned with technical activities.

Two of our foremost Federal laboratories are the National Bureau of Standards and the U. S. Bureau of Mines. The former carries on work relating to the standardization of test methods and test equipment and also engages in a large variety of general fundamental research. The latter engages in work for the mining industry and its correlated by-products. Both of these laboratories are doing excellent work and should be amply supported by the Government.

Many of our college laboratories are doing excellent work in the field of fundamental and industrial research. In fact, much of the industrial activity goes back to the fundamental work which is done in these laboratories.

Of the 1600-odd industrial laboratories in the country, approximately 270 are listed as commercial testing laboratories. Although in years past, many of these have engaged almost exclusively in commercial testing, there has been a trend in recent years for many of the better and larger ones to engage in research work of an applied type and in certain instances to carry on work of a fundamental nature.

Two of the research laboratories, namely, Mellon Institute and Battelle Memorial Institute, have refrained from work of a testing character and have engaged primarily in research work of an applied or fundamental nature.

One can not review the work that is being done in these various laboratories without appreciating the extent to which industry leans upon their findings for its further progress. Likewise, it is through work done at these laboratories that it is possible for organizations such as our own Society to carry forward their work in developing standard test procedures and standard specifications for the vast number of materials used in commerce and industry.

* Reprinted from the *A.S.T.M. Bull.*, No. 90, pp. 22-23 (Jan., 1938).

† President, American Society for Testing Materials.

LETTERS TO THE EDITOR

PIONEER DINNERWARE AT MOUNT CLEMENS POTTERY

January 14, 1938

My dear Mr. Purdy:

I have read with much interest the article in the December *Bulletin*, written by J. M. Wells, paying a much-deserved tribute to his father, W. E. Wells. I knew Mr. Wells, and I admired him as a fine gentleman, possessing great business and executive ability.

The article referred to was published by you as "ceramic history," and I think you will agree that *history* is of little value unless authentic. J. M. Wells states,

"In 1923, it was decided to make the greatest departure in pottery construction that had been attempted up to that date. As a result, Plant No. 6 was erected, which was designed exclusively for tunnel-kiln operation. Tunnel kilns, up to that time, had been in the experimental stage, and it was with considerable misgiving that the more conservative members of the firm entered into this undertaking."

The facts are that in the early winter of 1923 the Mount Clemens Pottery Company, at the request of the Homer Laughlin China Co., extended to them the courtesy of visiting our plant in Mount Clemens, Mich., to inspect the tunnel kilns we had in successful operation. Our tunnel kilns were built in 1920, and before 1923 all pioneer work had been completed and the kilns were definitely a success.

A group of the Homer Laughlin China Company officials, including Professor Bleininger, brought to Mount Clemens some of their unfired ware in clay, bisque-glazed and decorated, and, during a period of about a week, made firing tests of their own ware through our kilns. Naturally, these firing tests were successful, as the kilns had for two years been producing high-grade ware. This group of officials evidently reported favorably to their Company, and as a result, W. E. Wells and Marcus Aaron visited our plant to confirm the findings of their committee.

Immediately after these visits the Homer Laughlin China Company announced their intention to build "Plant No. 6." This they did, duplicating the type and style of kilns they had seen at Mount Clemens, as well as other advanced methods of plant lay-out and ware handling. No pioneering was involved; no risk was taken, as the trail had been blazed, and all that was necessary was for them to follow in the footsteps of a successful advance in dinnerware manufacturing.

I trust you will investigate and make sure this event in "ceramic history" is correctly recorded.

—CHARLES E. DOLL, *General Manager, Mount Clemens Pottery Company*

J. M. Wells' Reply to Mr. Doll

January 24, 1938

Mr. Doll has sent me a copy of the letter he wrote you January 14. The statements in his letter are substantially correct, and I certainly had no thought at the time I gave you the copy of the article on my father of taking any credit for pioneering that was due to any other person.

The only part of Mr. Doll's letter that is not entirely correct is a statement that we duplicated the Mt. Clemens kiln and plant layout. We did use the same type of kiln, but numerous changes were made in its construction, and there was very little similarity in our final plant layout to his shop at Mt. Clemens.

—J. M. WELLS, *The Homer Laughlin China Co., Newell, W. Va.*

SOME ASPECTS OF POTTERY DEVELOPMENT WORK IN MEXICO*

BY B. W. THORNGATE

The results of some of the experiments made for a company interested in technical industries in Monterrey, Mexico, are given in this paper.

An article was wanted which would be made from the clays found in the locality and which would withstand an inside pressure of 125 pounds per square inch and be impermeable at that pressure after being fired.

Several shapes were designed and used in the preliminary experiments; in general, they were small bottlelike containers having a capacity of 205 to 220 cubic centimeters. A tolerance of $^1/_{32}$ inch in fired shrinkage was allowed in the outside diameter of the mouth of the article.

A small laboratory was set up and only the most essential pieces of equipment were installed. These included a Denver Fire Clay Company high-temperature test kiln No. 100, a pebble mill, a No. 80-mesh screen, scales, plaster table, and a small blunger.

Natural gas from the Texas fields provided the fuel used in firing and Henderson pyrometric cones served as temperature indicators.

The glaze materials, except the clay, zinc, and iron oxides, were imported. Any other local materials which were available, including plaster of Paris, were used.

About fifty-five individual clays were tested. The two obstacles, usually present when workable clays were found, were that the deposit either could not be leased or the tonnage was too small. Many of the clays were analyzed to determine the lime content.

Two types of red-firing clays were found to be abundant in the State of Nueve Leon; No. 1 was semiplastic and sandy, and No. 2 was plastic and high in total shrinkage. Articles made with the latter clay cracked during the drying period.

These clays were mixed in certain proportions and were refined by passing the slurry through a 14-mesh screen. Afterward a second lawning was made through an 80-mesh screen, and the deflocculants were added. At no time were the clays filter-pressed.

The ware was cast in multiple molds made from plaster primarily intended for the building trade. Finer grinding helped to lengthen the life of the mold.

A continuous conveyer was experimented with in an attempt to make a casting machine, but its use remained problematical.

Tests were made to determine the minimum time required to dry both the ware and the molds. Trials showed that the body could be dried in two hours without danger of cracking with temperatures between 150° and 200°F.

Dry ware was placed in the test kiln at various temperatures. This ware was allowed to cool to various temperatures and removed from the kiln. Satisfactory results were obtained for low-fire bisque when dry ware was introduced into the kiln after the latter had been heated to 1000°F. The ware was fired for one hour to cone 015. Then the kiln was allowed to cool to 900°F and the ware was removed.

The cone 015 bisque was glazed inside by the fountain method and the outside was covered by spraying. The glazed ware was placed in the kiln, which had been heated to 1000°F, and was fired for $2^1/_2$ hours to cone 03. The kiln was allowed to cool for 2 hours to 800°F, and the ware

*Presented at Fortieth Annual Meeting, American Ceramic Society, New Orleans, La., March 27–April 2, 1938. Received February 3, 1938.

was removed without loss from cracking.

The glaze used was leadless, high in lime and boric acid, and colored by 7% ferric oxide.

Several hundred containers were made in the laboratory, filled with liquid, and capped in a bottling machine. Later these samples were checked for defects which affected the liquid.

After the laboratory tests were completed, various pieces of equipment were made to permit production on a larger scale.

A simple type of tunnel kiln was constructed. Fifty feet long and 40 inches wide inside the end zones, the design specified 12 cars and 5 Venturi-type burners.

The tunnel-kiln schedule for bisque ware (cone 015) permitted ware to be taken from the discharge end four hours after entering. The glost schedule (cone 03) required 2 additional hours or a total of 6 hours.

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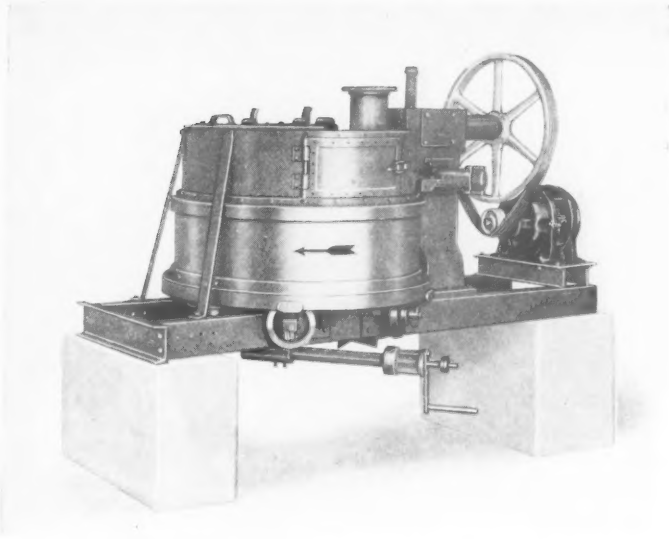

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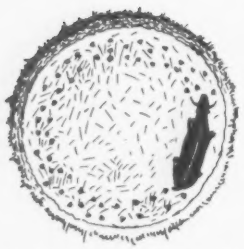
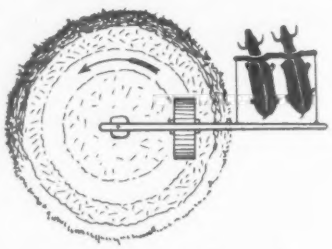


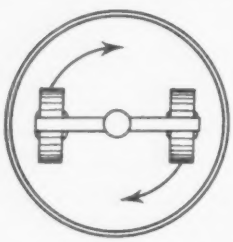
EARLY BABYLONIAN "MIXER"

We are told in history that centuries ago, in far off Babylon, while most brick fabricators were kneading bonding straw into brick-clay by laborious hand processes, some enterprising Babylonian dug a pit in the ground and after placing his brick materials therein caused his work-ox to be put there, too. The ox was driven in a circular path around the pit and the straw was trampled into the clay. The weakness in this method is the obvious "hit-or-miss" mixing action which was obtained, allowing spots of clay weak in bonding straw to remain after long periods of "mixing."



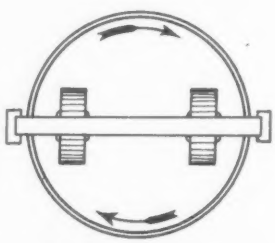
LATER BABYLONIAN "MIXER"

Not to be outdone by his competitor, some smart Babylonian improved upon the original "mill" by devising an ox-drawn mulling wheel which revolved in the pit while the animals remained at ground level. Greater speed and power were developed by this method but here, too, rich or lean spots remained in the batch.



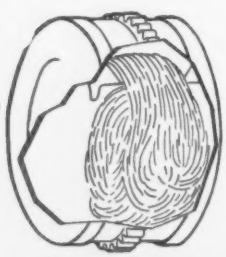
CHASER MILL
PAN STATIONARY - MULLERS MOVE

It was centuries before the next notable improvement in mixing machinery was achieved. This improvement consisted of a stationary pan with two or more rotary mullers revolving in it and was called the "chaser mill." It remained for years the best man could produce. But even with two or more mullers moving in one direction, in the same path, within a pan, rich or lean spots still remained in the batch after mixing.



"WET PAN" MIXER
MULLERS STATIONARY - PAN MOVES

Still another type of mixer was invented wherein the mixing pan was driven and the mullers revolved in one place. This was called the "wet pan" mixer and was the first system to carry the batch to the mulling device, a principle which was later to revolutionize the industry. With the "wet pan" mixer rich or lean spots still remain in the batch after mixing and the time, labor, and power consumed are beyond all reason.



"DRUM" MIXER
NOTE "FREE FALL"

The next type of mixer in the parade of progress employed the "tumbling" or "free fall" principle and was called the "drum" mixer. The materials to be mixed were caused to tumble together inside a revolving drum, falling over and over, directed in their path only by vanes inside the drum. This system did not produce homogeneity where materials of different grain sizes were used and therefore allowed rich or lean spots to remain in the batch.

Continued on next page

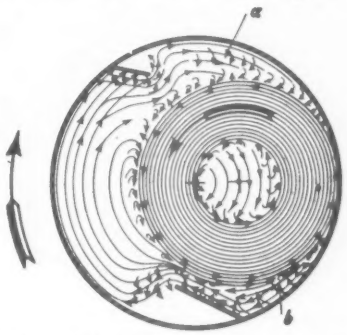
It remained for the Lancaster Iron Works, Inc. to invent, perfect and produce a Mixer combining all the best principles know to Mixing Science and by adding to and improving upon these principles, give to industry the very last word in Mixing SPEED, ECONOMY and EFFICIENCY.

That's the famous "LANCASTER"

SCIENTIFIC COUNTER CURRENT RAPID BATCH MIXING SYSTEM

Arrangement of
Pan with Plows and for Mullers

Diagrammatically the LANCASTER Mixer is shown on the left It consists of a pan moving slowly in one direction which *carries the batch* into a whirlpool area created by an arrangement of plows and/or mullers moving at a higher speed in the *opposite direction,* off the center of the pan. Note also the diagram at the right in which is plotted the intensive mixing action obtained with a LANCASTER Mixer. The advantages of the LANCASTER System are too many to list here. Just a few are....



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4— Power Costs reduced as much as 50%.

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6— Small in size.

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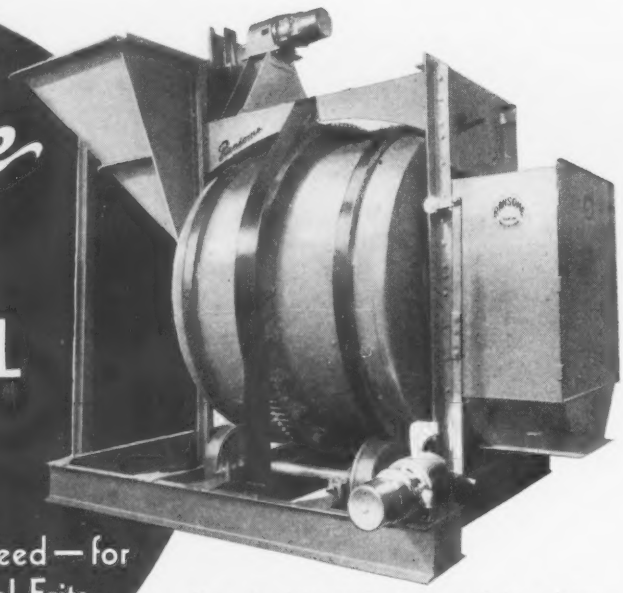

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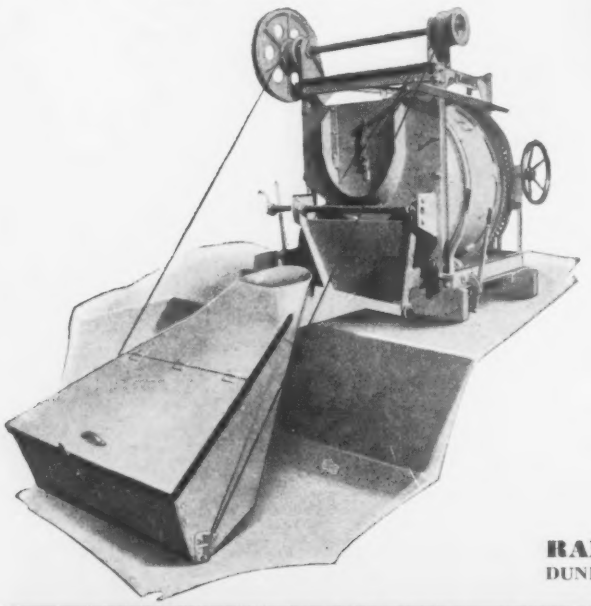
Electrically driven open revolving paddle type mixer. Used for mixing refractory plastic cements and other plastic materials.

RANSOME Glass Batch Mixers with power loader for use where raw materials are located on same floor level as mixer.



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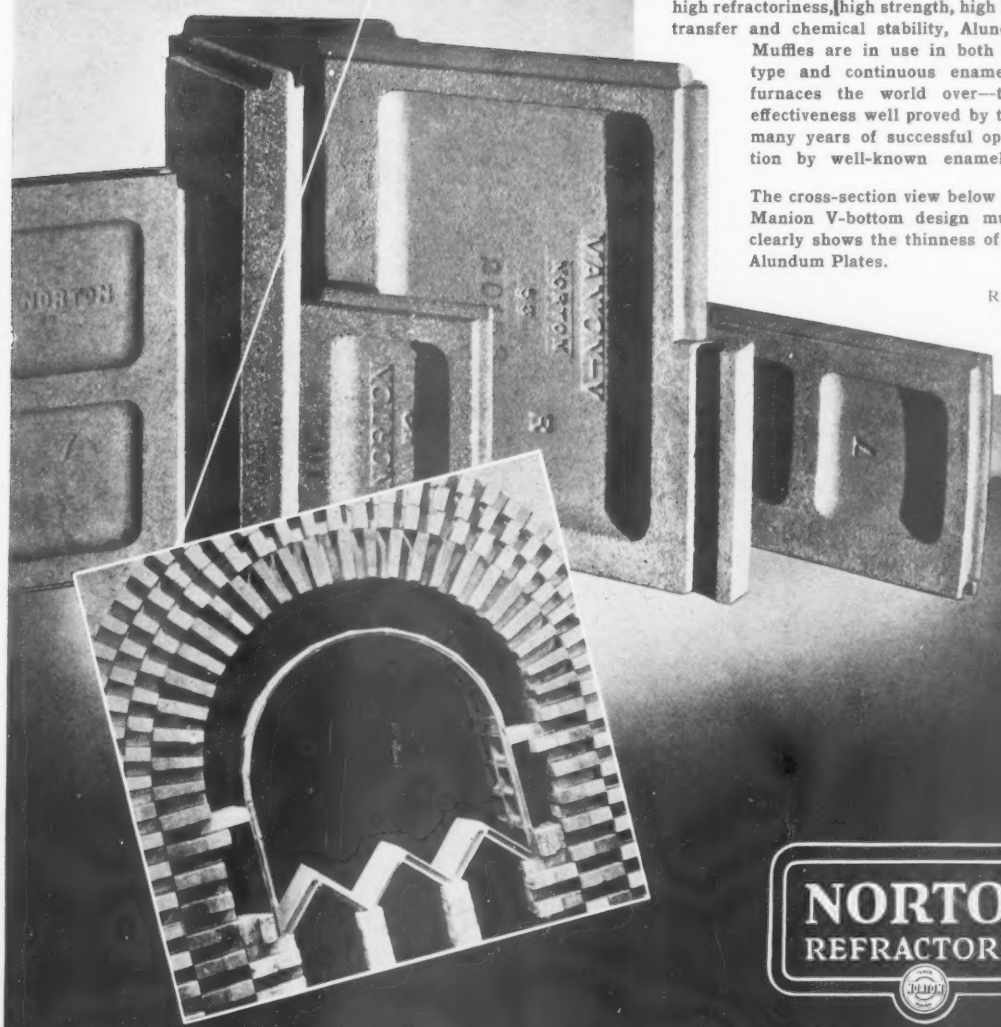
R-588



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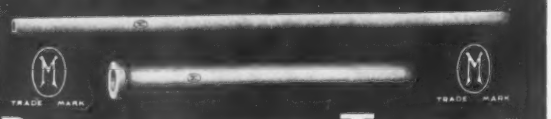

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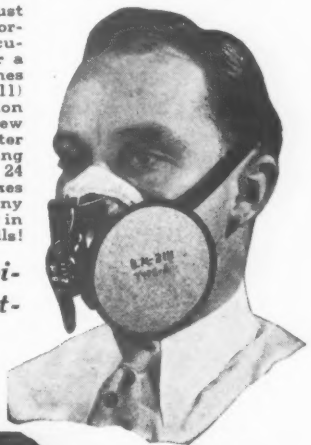

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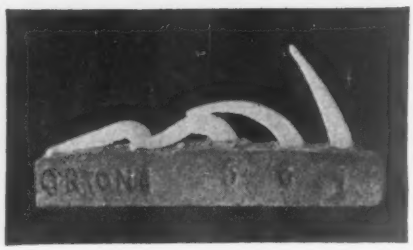

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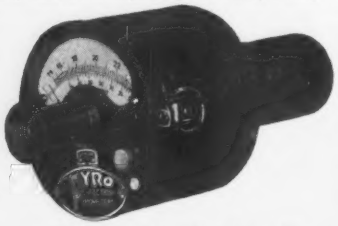

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General Manager
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M and T

SODIUM ANTIMONATE

Every lot of M and T sodium antimonate must pass eleven exacting physical, chemical, and enameling tests before it is shipped from the factory.

These tests prove the absolute uniformity of both the product and its performance. They prove that M and T sodium antimonate is entirely free from chemical or physical variations—that it is always of the highest quality which selected raw materials, scientifically processed, can produce.

The many users of M and T sodium antimonate take no chances when they continually choose this superior product.

METAL & THERMIT CORPORATION, 120 BROADWAY, NEW YORK, N. Y.